Regulating the environmental impacts of the Libyan aggregates industry.

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Regulating the Environmental Impacts of the Libyan Aggregates Industry

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Abstract

This research is concerned with the Libyan aggregates industry, which, as far as can be determined has not been extensively investigated before. Its key aim is to establish the environmental effects of quarrying in Libya and the regulatory regime to control them, with reference to the institutional framework and social and cultural influences in Libya. The research is intended to achieve a better understanding of the aggregates industry and to identify the key factors which have formed its current status, and also to investigate the main barriers constraining the regulatory regime controlling the aggregates industry. Theoretical and empirical studies were conducted between 2004 and 2006 in Libya. The theoretical research focused on the aggregates industry and its key issues. The empirical research was carried out in Libya to collect information regarding the environmental impact of the Libyan aggregates industry as well as managerial and employee attitudes towards it. The data were obtained through interviews targeting the employees of government organisations' supported by a number of questionnaires with the quarry staff. The data gathered from the questionnaires and the interviews were analysed using Excel and SPSS Software.

As a result of this study numbers of issues have been discovered with regard to the Libyan aggregates industry and its environmental impacts. It was discovered that the environmental impacts of aggregate extraction are very serious in Libya and the environmental protection plan that attempts to control them is weak. This research has highlighted those environmental impacts and the barriers facing the implementation of the environmental protection plan to control these impacts. It was discovered that there are high numbers of quarries working without permission. The selection of quarry sites in the country seems to be based on nepotism and there is a complete lack of any initial environmental protection training for quarry staff and for new recruits. Within the aggregates companies investigated, there is a total absence of environmental departments and environmental laws and regulations are not of major concern to aggregates industry staff. The research has highlighted the importance of social and economic changes and the influence of tribe and family and people's attitudes to environmental protection and the implementation of the environmental regulations.

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List of Abbreviations

The following are the abbreviations which are used in this thesis

EGA	Environmental General Authority
IRC	Industrial Research Centre
GPC	General Peoples Congress
NAID	National Agency of Information and Documentation
DL	Dinars of Libya
CBMR	Centre of Building Material Research
EIA	Environmental Impact Assessment
ASTM	American Society for Testing and Materials
DOE	Department of Environment
TCEP	The Technical Centre for Environmental Protection
EMS	Environmental Management System
CGER	Commission on Geosciences, Environment and Resources

Dedication

To my beloved parents, grandmother, brother (Abdallh), sisters, wife and son (Abdalrhman) for their continuous support, patience and love.

Acknowledgement

First and foremost, I give thanks to God for all the care and help offered throughout the different phases of this research. My recognition, gratitude, and appreciation to my supervisors **Dr. Mike Heath** and **Dr. Ernie Jowsey** for Their help, support, motivation and excellent supervision during my study for Ph.D. Also I would like to thank them for reading and making constructive suggestions to the successive drafts of my work. Their tolerance, patience, guidance, understanding and encouragement are sincerely appreciated. My special thanks are also due to **Professor Alan Griffith**, my Third supervisor, for his constant and valuable guidance and comments throughout the duration of this study.

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Finally, the author owes special a debt to his country Libya for financing his post-graduate education. My deep thanks and gratitude are to my father for his help and support, my mother, sisters, brother (Abdallah) for their continuous support, patient and love. Special thanks go to my wife and son (Abdalrhman) who missed my care during the duration of the research; without their patience, support, assistance and encouragement this thesis would never have been completed.

Declaration

I hereby declare that I am the author of this thesis; that the work of which this thesis is a record has been done by me, and that it has not previously been accepted for a higher degree. However, some parts of this thesis have been published in co-authorship with Dr. Mike Heath in the following paper:

- **Masoud, M.A and Heath, M.J (2006)** The environmental impact of the aggregate quarrying in Libya. Proceedings of the International Symposium, 2006. Environmental Issues of Mineral Industry. PP 291-298. MINTECH Publications, India, 2006

Mohamed A Masoud 2007

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CHAPTER ONE

Chapter One
Research Background

1.1 Introduction

This chapter of the thesis will give the reader some background into the purpose and the subject area of this research. It begins with a brief description of the aggregates industry, the need for the study, and its aims and objectives. The chapter ends with a presentation of the structure of the thesis.

1.2 The Research Problem

Quarrying is in most cases defined as surface mining of naturally occurring minerals such as sand, gravel and rock. The quarrying industry is an important industrial sector in the modern world and the use of aggregates goes back to the dawn of civilisation, being practised over a very long period of time from the ancient Egyptians, Greeks and Romans to the present day (Masoud et al, 1998). The important role of aggregates in society will not diminish in the future, because every year millions of tonnes of aggregates are produced all over the world for use in construction of homes, schools, railways, roads for public transportation etc (Bobrowsky, 1998).

Aggregate quarrying is mostly open surface working and in all cases it has impacted upon the environment to a greater or lesser degree depending upon scale of operation. Aggregates extraction leads to a wide range of environmental impacts, the most significant being airborne dust, ground vibrations, noise, traffic, water pollution, soil erosion and visual intrusion. Not all of these effects exist in every quarry, but in most cases there is combination of impacts depending on geological conditions (Solar, 2002). These impacts are perceived by the public as a threat to the things they value, and they have the great potential to affect people's quality of life, through loss of amenity, potential loss of health, lowering of property values or loss of a local beauty spot or popular viewpoint. These issues are often considered to be the most significant in terms of generating public concerns (Coppin, 1989). In an era of sustainable development and increased environmental awareness, aggregates industry activities are considered by elements of the general public to have a detrimental effect on the environment. As a result, it is extremely rare for planning applications for new quarry sites, or extensions to existing sites to not be subject to objections (Gosling, 1990). Some consider that the aggregates industry now attracts more opposition than any other form of planning proposal (Norman, 2001).

Libya is a North African country, which is developing rapidly. It has several environmental problems, including lack of water resources, soil erosion, desertification, salinisation, sedimentation and reduction in biodiversity that are partly caused by the climate. These are compounded by development processes such as industrialization, urbanization and population growth (Masoud *et al*, 1998).

The extensive urban development in the state of Libya over the past four decades has created a great demand for aggregates in housing projects and road construction. To meet that demand over the past two decades, a number of quarries have been significantly expanded, which has led to extensive exploration of aggregate deposits especially in the northern part of the country where most of the population is concentrated (Masoud *et al.* 1998). Consequently, most of the quarries have been opened near urban centres to meet local demand and this has caused a lot of environmental problems.

The Libyan government in common with many developing countries is now giving more attention to environmental safety issues and control of pollution by issuing legislation regulating these different issues. Attention to environmental issues in the Libyan aggregates industry has grown since the beginning of the 1990s, but during the late 1990s environmental protection in the aggregates industry has shown no real improvement. This may to some extent be because of the UN sanctions applied in relation to the Lockerbie Issue; the imposition of UN sanctions brought changes in Libyan environmental programmes due to lack of facilities and lack of environmental training programmes which used to be provided by foreign companies, either by expatriates in Libya, or abroad at the foreign companies' headquarters (Nauar, 1997). This vital link in the building of a proper environmental protection plan was lost due to the sanctions. The policies adopted do not seem to have resolved the problems; for example, there are still quarries working without permission or not willing to implement the environmental laws and regulations. However, since the sanctions were suspended in 1999 the Libyan government has taken a number of steps to improve environmental protection and achieve sustainable development. These steps started with various amendments to its environmental laws and regulations, such as Law No 15 of 2003 in protecting and improving the environment, which replaced Law No7 of 1982 in regard to environmental protection. The Environmental General Authority has also produced the guidance notes for the aggregates industry and these are the first guidance notes in Libyan environmental regulations.

So, despite the many efforts in environmental protection, Libya still faces unresolved problems, which may affect the degree of success of the environmental protection plan. A survey of the literature on the environmental impacts of the aggregates industry in Libya reveals that little attention has been given to the environmental laws and regulations. More importantly, the assessment of the implementation of current environmental policies is far from clear. This means that there is a lack of extensive and formal empirical research. There is a need, therefore, to assess the implementation of environmental policies in Libya and the main barriers facing their implementation. It appears that environmental policy is being blamed for most of the environmental problems in the aggregates industry. A study of the existing situation will facilitate a better understanding of the problems and factors which have affected the implementation of environmental policy. In addition, no attempt has previously been made to examine whether or not the government is successful in implementing its environmental policy. Therefore this study is an attempt to fill this gap and to consider all of the above issues.

1.3 The Research Aim and objectives

1.3.1 The Aim

The aim of this research is to investigate the environmental effects of quarrying in Libya and the regulatory regime to control them with reference to the institutional framework and social and cultural influences in Libya.

1.3.2 The Research Objectives

In line with progression towards achieving this aim, the research has the following key objectives:

- Review the current environmental regulatory regime in Libya and compare it with the UK system;
- Identify and develop appropriate research methods in order to address any gaps in data;
- Examine and assess the effectiveness of the Libyan regime in ensuring control of environmental effects to achieve sustainable development, with reference to land use, operational effects, wastes, restoration and resource depletion;
- Taking into account the temporal and spatial dynamics of the Libyan quarrying industry, identify shortcomings of the environmental regulatory regime;
- Investigate and explain the social and cultural context of relationships in Libya which may influence industrial regulation;
- Make recommendations for an appropriate regulatory regime for Libya to control environmental effects now and in the future;
- Identify related areas of further work required.

1.4 Research Questions

The process of the development of research questions in this study was based on a review of literature on the aggregates industry, the previous experience of the researcher, and early fieldwork in Libya. In addition, the questions were also improved by discussions with specialists, and were finally revised and amended throughout all the phases of the research process in order to meet the purposes of this study. At the end of this process, the study attempts to answer the following key questions:

1. Why has the Libyan aggregates industry created environmental impacts and why has the planning system been ineffective and failed to control them?
2. What are the main environmental polices that have been adopted during the last two decades?
3. Who are the parties responsible for implementing these polices?
4. What are the main factors that make the planning regime ineffective?
5. What can be done to improve the current planning regime?

1.5 Significance of the Study

Given the absence of any prior major studies of the aggregates industry, the major significance of this study is that the industry is now better investigated, understood and documented. This will help policymakers and decision makers and others concerned with the aggregates industry and its processes, operations and environmental impacts in Libya to gain a fuller understanding of the industry. This should enable them to make efficient decisions to formulate short and long term environmental protection strategies and policies to improve environmental protection in the industry's processes and operations. Also there are three other key reasons which make this study significant:

1. The study fills a gap in knowledge in the literature relevant to the Libyan aggregates industry, and introduces and documents the industry for research into the aggregates industry both in general and, particularly in developing countries.

2. The study assists government departments and decision makers to be aware of the significance of the Libyan aggregates industry in economic growth and the development process.
3. The study can be considered as a milestone and a significant reference for future research. The value of this research is highlighted in Section 9.7.

1.6 Study Methodology

The aim and objectives of the research will be achieved by the collection of both primary and secondary data. This will involve three separate activities as follows: firstly, conducting a review of the literature; secondly undertaking a piece of empirical study in Libya to collect information regarding the environmental impacts of the Libyan aggregates industry, as well as managerial and employee attitudes towards it; and finally, by investigating documentary evidence and conducting a case study of government organisations in Libya, through the use of interviews and questionnaires, to identify and analyse the environmental impacts of the aggregates industry and all barriers facing the current regulatory regime to control them.

With regard to the fieldwork, qualitative techniques will be used as a main data collection method. Even though qualitative and quantitative research is often compared, the two approaches are very different and have developed into different process paradigms; it is believed by theorists (Bryman 1988, for example) that quantitative and qualitative research are complementary, and that a combination of both enables the researcher to acquire a better understanding of what is being studied.

The review of the literature relating to environmental impact of aggregates extraction will be conducted through library and Internet research in which textbooks, journal articles, bulletins, newsletters, professional body publications, and seminar reports pertaining to the subject matter will be used. In particular, research in similar cultural contexts to Libya will be sought.

Additionally, the author will conduct two pilot studies to identify problems that might occur with questions posed in semi-structured interviews with government organisations employees, and in a questionnaire to be administered to quarry staff. The content validity of interviews and questionnaire questions was achieved through review carried out firstly by the researcher's supervisors. Secondly the Arabic version of those questions was submitted to four Arabic and Libyan students for revising and strengthening the Arabic translation and finally the questions were piloted in the case study organisations.

The entire research process can be seen in Figure 1.1.

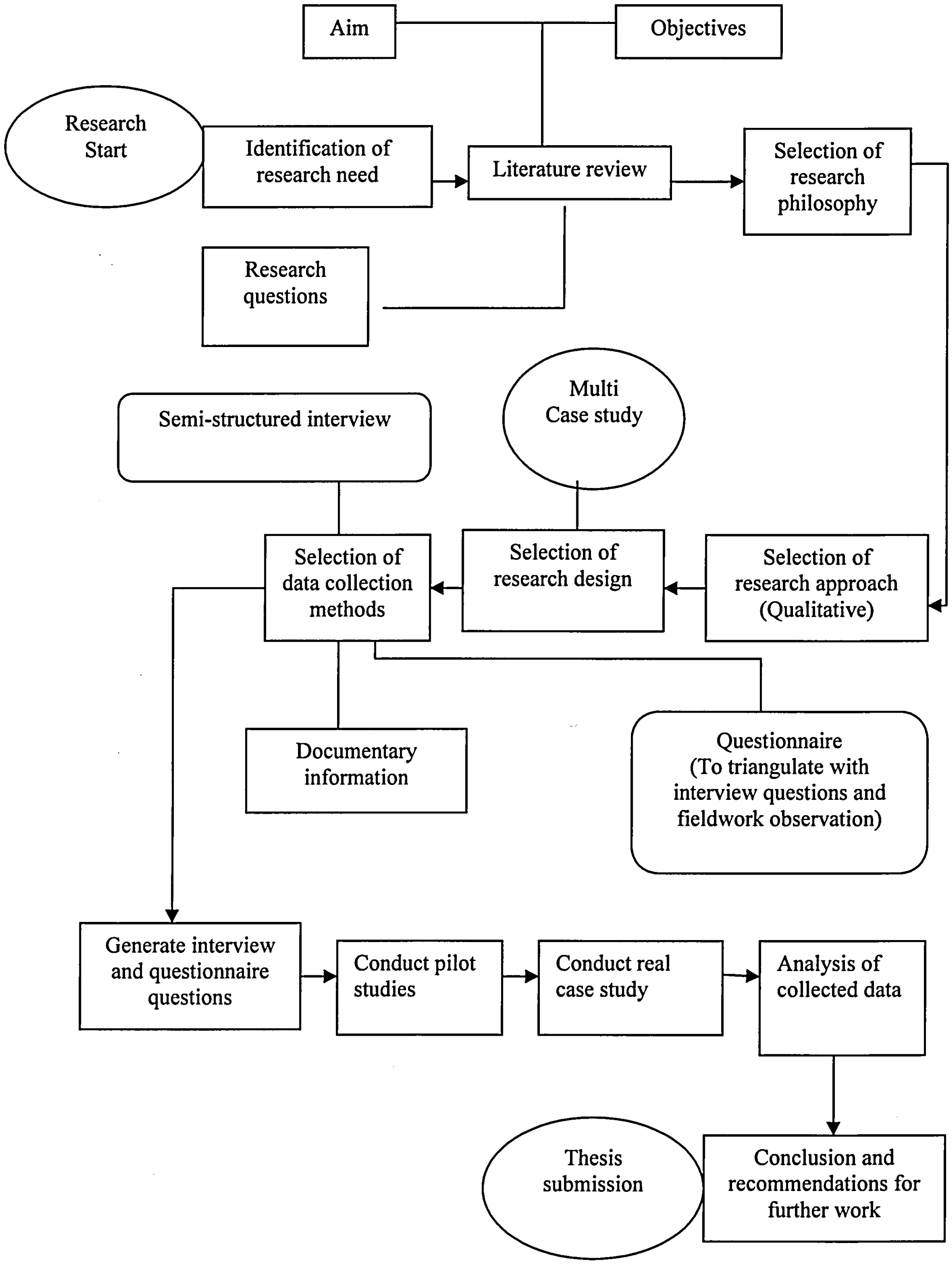

Figure1.1 Research Process

1.7 The Structure of the Thesis

The thesis is divided into Nine Chapters as follows:

Chapter One presents an introduction to the problem, the need for the research, its aim and objectives, significance of the research, the methodology to be used, and how the thesis will be structured.

Chapter Two presents the background to the Libyan environment, through a discussion of geographical, geological, social/educational, political, economic and cultural aspects. Libyan aggregates industry development, its regulatory regime and the development of environmental policy will be discussed.

Chapter Three presents a review of the aggregates industry and its key issues and aspects. This includes a review of the UK aggregates industry covering its development, with particular focus on the development of the regulatory regime.

Chapter Four presents a review of the environmental impacts of the aggregates industry and how they can be controlled using best practice.

Chapter Five discusses the research methodology employed in the study, including the issues related to the research design and the development of the research instruments (semi-structured interviews, questionnaire and documents). It also provides a rationale for choosing the case study technique and the particular research instruments used within it.

Chapter Six presents the fieldwork findings and the key issues of the industry.

Chapter Seven provides a discussion and analysis of the results obtained from the questionnaires and interviews.

Chapter Eight provides a discussion of the results obtained from the fieldwork, questionnaires and interviews in light of the literature in relation to the research aims and objectives, and provides recommendations to improve the current situation in the aggregates industry and in Libyan industries generally, in the area of environmental protection.

Chapter Nine presents the overall conclusions to the research.

1.8 Chapter Summary

This introductory chapter has outlined the research problem and the aggregates industry in Libya. From this introduction, the aims and objectives have been identified and a proposed mixed methodology using qualitative and quantitative research techniques involving the government organisations' employees and aggregates industry staff has been outlined. The next chapter will provide a review of the Libyan environment.

CHAPTER TWO

Chapter Two
The Libyan Environment

2.1 Introduction

The purpose of this chapter is to provide information about the environment of Libya, its industrial development and its influence upon management activities in general and environmental protection in particular. By investigating the environment in such a way, the author will be able to determine barriers to the development of environmental protection in the aggregate industry, and offer suggestions for improvements both there, and in Libyan manufacturing organisations in general.

According to McGuire, (1964) the word 'environment' describes the conditions, both natural and man-made, under which people carry out their activities. A country's environment has a great influence on both managerial and organisational behaviour, with regard to the evolution of management approaches, method and management thinking in general. This influence is associated with a long history of social traditions, with religion and with political and economic ideology, but for this research the discussion will focus on the prevailing social, political and economic conditions in Libya under which environmental protection and environmental protection development are performed.

2.2 Management in Libya as a Developing Country

Jaeger and Kanungo (1990) cited that the developing countries imported modern management theories and techniques to speed up their industrial development. Many organisational practices and management programmes in the developing countries are based on the adoption of the experience of the developed countries model without taking into consideration cultural constraints and the wide gap between cultural values of developing countries and the values practiced in the developed countries. Furthermore, Jaeger and Kanungo (1990) said that organisational structures in developing countries are hierarchical, status-oriented and decisions are made on the basis of non-rational criteria. In Libyan organisations, Agnaia (1996) mentioned that during official working hours little attention is paid to the importance of time as employees spend a lot of time meeting their visitors. The majority of people working in public organisations do not follow the rules and regulations of their managers. As a result administrative mistakes increase, which lead to a delay in achieving the organisation's objectives, and difficulty in performing many policies such as environmental polices.

2.3 Geography and Climate

Today Libya is officially called the Great Socialist People's Libyan Arab Jamahiriya (GSPLAJ). Libya is an African country situated on the southern Mediterranean coast , approximately between latitude 18°00' and 33°00' North and 9°00' and 25°00' East and has a Mediterranean coastline of 1,900 kilometres and is about 1,450 kilometres from north to south. To the north, the country is bounded by the Mediterranean Sea, to the east by Egypt and Sudan, to the south by Niger, Chad and Sudan, and to the west by Algeria and Tunisia. Libya has an area of 1,700,000 square kilometres, it is the fourth largest among the countries of Africa and fifteenth among the countries of the world, but about 95% of Libya's land is desert except the area near the coast, which has a Mediterranean climate. The three component areas of Libya are Tripolitania (renamed the Western Region), Cyrenaica (renamed the Eastern Region) and Fezzan (renamed the Southern Region) (Masoud, 2003). A map of Libya is provided as Figure 2.1.

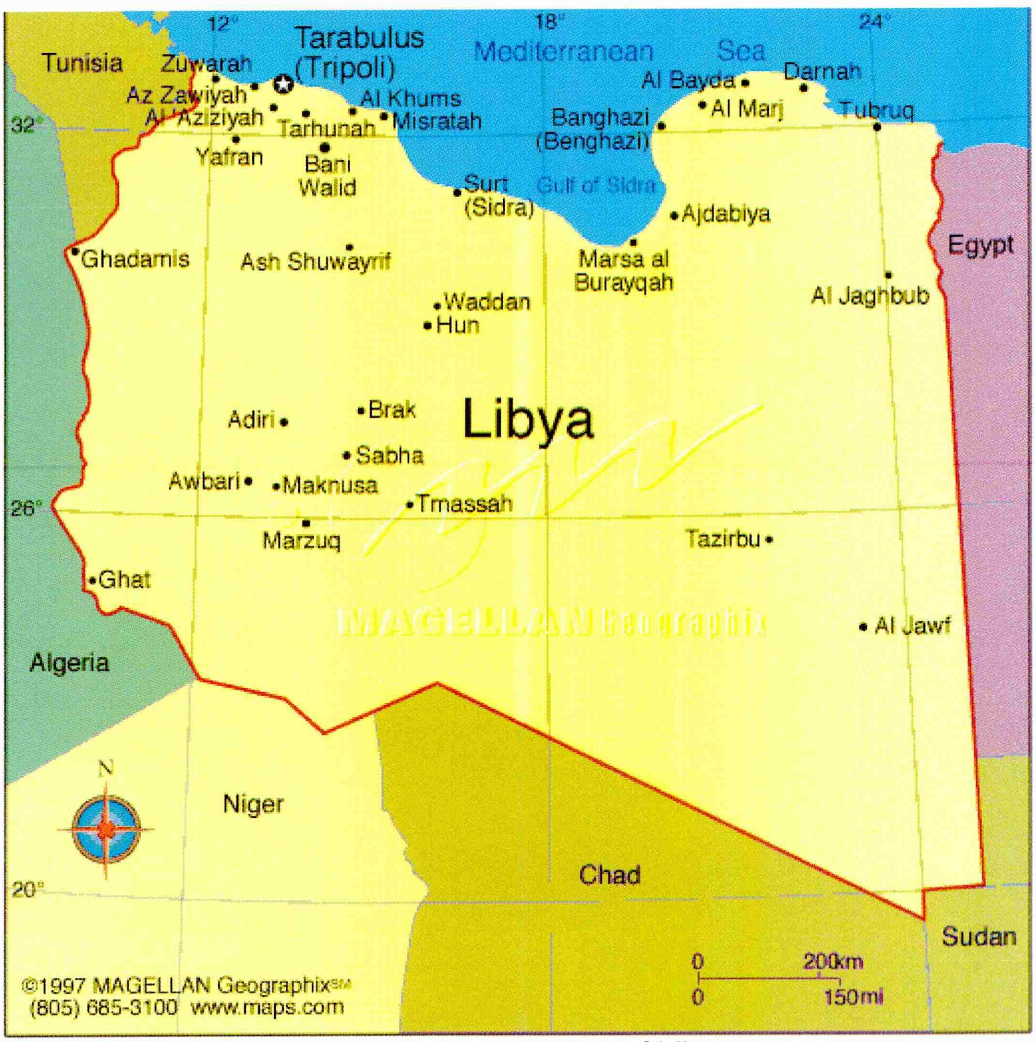

Figure 2.1: Map of Libya
(Adopted from: media.maps.com)

The spatial structure of development in Libya is a product of environmental conditions and economic aspects. Desert land and water shortage have eliminated the possibility of development over a substantial portion of the country.

The most favourable living conditions are found in the rainfall areas of the coastal plains in the Tripoli and Benghazi regions which comprise only 1.7 percent of the total area of the country. These are the most densely populated, heavily cultivated and economically developed parts of the country. These areas accommodate 75 percent of the total population, 84 percent of the total urban population and 94 percent of the manufacturing establishments (SOU, 1981, 1985). This is clearly a very concentrated area of urban development.

Climatic conditions are influenced by the Mediterranean Sea to the North and the Sahara in the South. There are five climatic zones recognised within Libya. Most of the coastal areas, where more than 80 percent of the population lives, have a Mediterranean climate, with warm summers and mild winters. In the south (desert areas) the climate is characterised by very hot summers and extreme diurnal temperature ranges. Rainfall is scarce, and less than two percent of the country receives enough rainfall (TCEP, 1992).

2.4 Geological Setting of Libya

Libya his been part of the Mediterranean forelands of the African shield since Early Palaeozoic times, it has been the site of deposition of extensive sheets of continental clastic sequences, with many intercalations of marine deposits.

These cycles of sea level change, transgression and regression have thus led to the accumulation of a wide variety of sedimentary rock (Masoud, 2003).

Several tectonic cycles and orogenies have affected the region and formed the major structure elements of the country. Five sedimentary basins have been recognised namely Chadames, Murzuq, Kufra, Marmarica and Sirt basin, separated by intervening uplift arches (Figure 2.2)(Conant and Goudarzi, 1967).

Libyan aggregates are extracted from different kind of rocks and from different geological ages. These rocks have been selected by the aggregates industry according to the rock quality, strength and its potential usage as aggregate material. They are widespread all over the country (Figure 2.3 and Table 2.1) Msalati (1995) summarises it as follows:

2.4.1 Paleozoic Rocks:

These rocks are found in the south of the country in Tbisti Mountain, Murzuq Basin, Kufra Basin and Arkno Mountain. The Paleozoic rocks have not been used by the aggregate industry except for Dembabh formation. It consists of siltstone to marl beds with few sandstone beds. The lower part contains limestone with green shale.

2.4.2 Mesozoic Rocks:

These rocks are found in the northern part of the country in Aljabal Elgarbi Mountain and Aljabal Alakdar Mountain. The Mesozoic rocks are the most used rocks by the aggregate industry. They consist of limestone, sandstone, claystone and salt deposits (Table 2.1).

2.4.3 Cenozoic Rocks:

These rocks are found in the northern eastern part and in the central part of the country. The Cenozoic rocks are also used by the aggregate industry. They consist of limestone, dolomitic limestone or marly limestone beds rich in fossils. All the Libyan building stone is produced from Calcarenite deposits which contains limestone, fossils and some sands. These deposits are widespread along the coast line in three main formations, which are Gergarsh Formation, Ajdabia Formation, and Al-Broq Formation which are Quaternary and Tertiary in age.

The gravel and crushed rock is produced from dolomitic limestone or dolomite rock or hard sandstone. These deposits are widespread all over the country in different geological ages as in Table 2.1. Sand is produced mainly from the Mesozoic deposits in Abushibah Formation and Keklah Formation which consist mainly of fine sand with sandy clay. Gypsum is produced from Bar Al-Ghanam Formation which consists of high quality gypsum and its thickness ranges from 10-750 meters

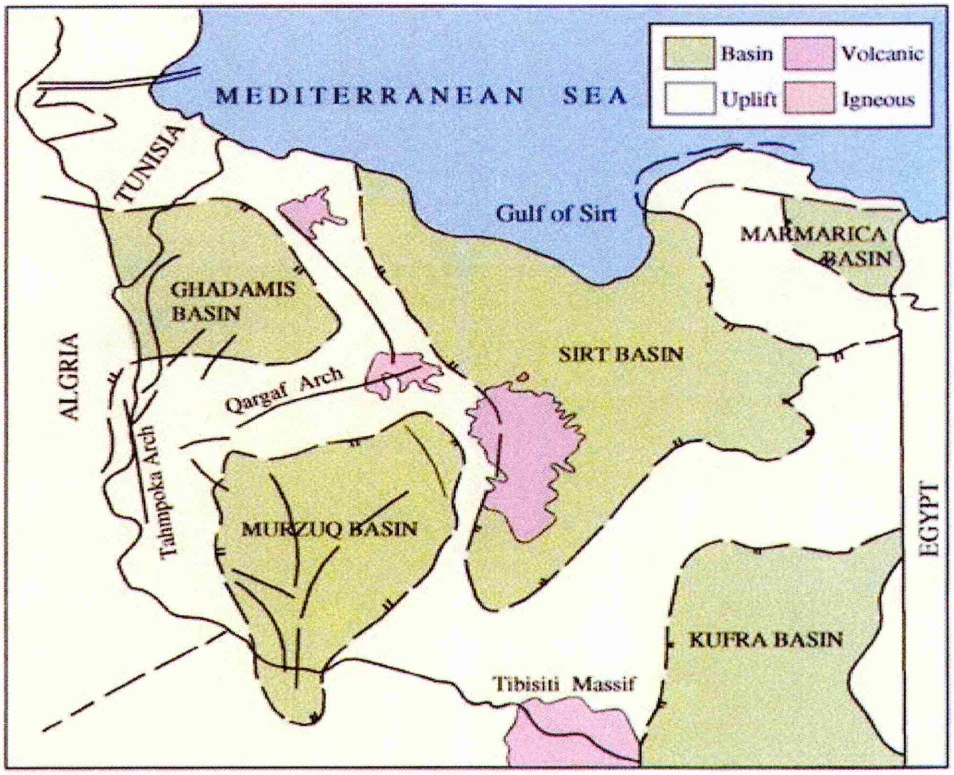

Figure 2.2 Major Sedimentary Basins Onshore Libya (Masoud, 2003)

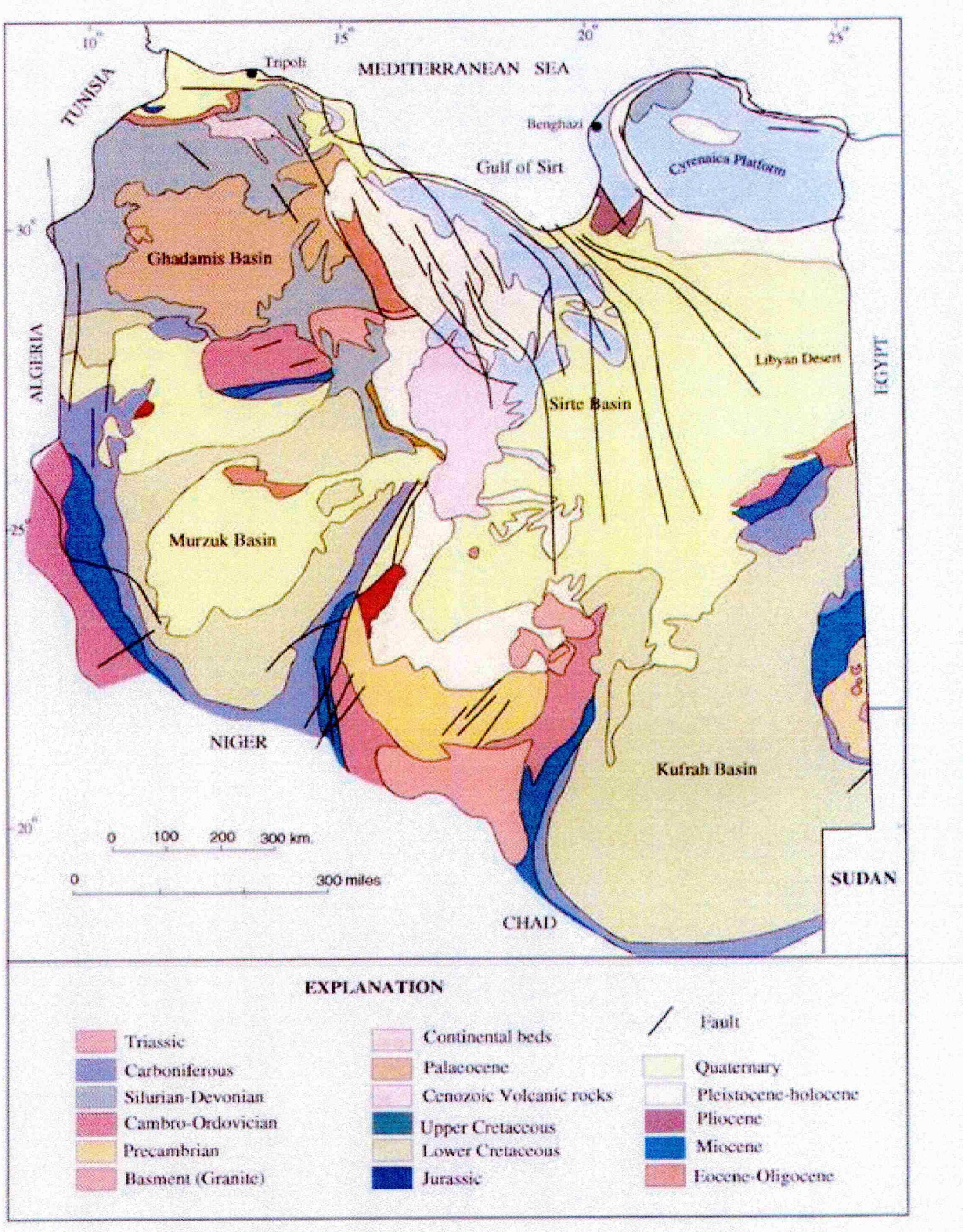

Figure 2.3. Generalized Geological Map of Libya (Simplified from Conant and Goudarzi, 1967).

Age	Formation Name	Member Name	Description
Pliocene and Pleistocene	Gharah widah Formation		It's covered by caliche bed with sand and sandy clay. thickness about 32 meters
Pliocene	Mahroqh Formation		Consist of dolomite and dolomitic limestone. Its thickness about 12 meters
Miocene	Al-Komas Formation		Consist mainly of limestone and calcarnite with some interbeds of marly limestone in its top.
Lower Miocene	Al-Gagbob Formation		Consist of limestone and cretaceous limestone rich in fossils with some concretions of conglomerate.
Middle Miocene	Al-Rajmah formation	Bangazi Member	Consist of thick beds of limestone rich in fossils with interbeded of marl or dolomite.
		Wadi Al-Gatara Member	Consist of dark grey limestone rich in fossils with some concretions of chert or gypsum. Its thickness range from 20-60 meters
Upper and Lower Miocene	Al-Fadiha Formation		Consist of mainly from limestone with small beds of marl in some places. Its thickness range from 50-140 meters
Oligocene	Al-Bidah Formation	Sahat Member	Consist of yellow marl and marly limestone with fine limestone interbeded. Its thickness range from 20-90 meters
		Limestone Member	Consist of thick beds of limestone. Its thickness range from 10-70 meters
Eocene	Darnah Formation		Consist of thick beds of white limestone. Its thickness range from up to 270 meters
Paleocene	Almajaher Formation		Consist of marly limestone, dolomite and dolomitic limestone with some muds. Its thickness up to 205 meters
Upper Cretaceous	Side Al-said Formation	Yafren Member	Contains dolomitic limestone with some beds of marly limestone.
		Ayen Tobee Member	Contains dolomite with some sandstone and quartz
	Nalut Formation,		Contains dolomitic limestone with small beds of marly limestone. Its thickness 200 meter
	Khser Tagrna Formation		Contains thick beds of limestone with small beds of marly limestone changing to sandstone in some places. Its thickness range from50-120 meters
	Mizdah Formation	Mazoza member	Contains grey limestone with some concretions of chert. Its thickness 25 meter
		Thlah member	Presents as small hills from gypsum or marl
	Zamam Formation	Lower Tahr Member	Contains limestone with interbeded of marly limestone. Its thickness range from 10-90 meters
		Upper Tahr member	Contains mostly from marl and few claystone with interbeded of limestone. Its thickness range from 5-10 meters
		Alhad limestone member	Contains marly limestone and dolomitc limestone. Its thickness 25 meters
	Alshorfah Formation	Aburas member	Contains marly limestone with interbeded of marlstone and mudstone Its thickness range from 6-33 meters
		Algelth member	Consist of dolomite and dolomitic limestone with interbeded of marly dolomite. Its thickness range from 20-60 meters
		Ammor member	Consist of dolomite and dolomitic limestone with interbeded of marlstone. Its thickness range from 10-19 meters
Lower Cretaceous	Msak Formation	Jerma member	Contains sandstone with interbeds of marly claystone. Its thickness 80 meter
		Aoubari member	Contains weathering sandstone with conglomerate.
Jurassic	Keklah Formation		Contains sandstone with interbeds of claystone and limestone. Its thickness 250 meter
	Bar Al-Ghanam		Contains a high quality Gypsum. Its thickness ranging from 10-750 meter
Triassic	Abushibah Formation		Contains sandstone and sandy clay with interbeds of limestone or dolomitic clay part of it with silica. The upper part contains mudone with sand. Its thickness ranging from 30-50 meter
	Aziziah Formation		Contains dark grey limestone part of it with silica and other with dolomite and small beds of sand and chert. The lower part contains limestone with sand. Its thickness 105 meter
Carboniferous	Dembabh Formation		Consist of slit to marl beds with few sandstone beds. The lower part contains limestone with green shale. Its thickness range from 35-85 meter

Table 2.1. Showing Gravel and Crushed Rock Deposits Divided by Formations. (Source Msalati 1995)

2.5 The Population

Farley (1971) believes that the character and skills of any population determine the character and the success of its development, but also says that the economic status of a country determines the material quality of people's lives. In Libya, according to Farley, there is a striking imbalance because the human resource situation is frustratingly weak, whereas the financial situation is exceptional because of oil revenue. Quin (1961) points out that according to the population census, which was taken by the Italians in 1936; the total population of Libya was 848,910. The first population census after independence was conducted in 1954 with the help of the United Nations (UN) and the total population of the country was 1,041,099.

In Table 2.2, it can be seen that there was a rapid growth in the Libyan population (from 1,041,599 to 4,748,000) during the period 1954–1994 with an astonishing rate of increase of 356%.

Table 2.2; Population Change in Libya from 1954–94 (Source: Secretariat of Planning, (1995)

Year / Sex	1954	1964	1973	1984	1994	1954/94
Libyan male	540,364	788,657	1,057,919	1,653,330	2,420,500	348%
Libyan female	501,235	726,844	994,453	1,583,830	2,327,500	364%
Total	1,041,599	1,515,501	2,052,372	3,237,160	4,748,000	356%

This relatively small population has constrained the availability of the workforce for economic development, which is considered a major obstacle to economic growth. Furthermore, says Kabbur (1995), the insufficient number of workers in the economy, is exacerbated by barely adequate skill levels and low productivity. Therefore, although Libya recognises the importance of human resources in its ambitious development programmes, the size of the population as well as the limited role played by women in the economy, limit this development. Despite development programmes for human resources education and training, in 1990 only 21.2% of the population were in paid employment and only 10% of this workforce was female. Libyan culture and particularly the social structure have created this environment (Kabbur, 1995).

Independence and the discovery of oil made Libya more stable and considerable improvements in the standard of living and health services led to a reduction in the death rate, and an increase in family size. Also, life expectancy increased substantially which led to general population growth. However, with a higher level of education people tend to reduce the number of children, which may account for the recent relative decline in the population growth rate. Compared to other countries, the Libyan population density is very small at three people per square kilometre. This is a result of the fact that most of the area in the country is desert and people tend to live in the few cities and towns, which are now becoming over-populated. The population size has had a major impact on the availability of a labour force capable of responding to Libya's plans for development, since insufficient numbers of Libyan nationals, together with the low participation of women in the workforce (due to traditional customs that restrict their working) have combined to create an inadequate pool of qualified labour. As a result, there are large numbers of foreign workers in the country.

2.6 Social and Educational Development

After the discovery of oil, many people moved from the villages to the cities in order to find better-paid jobs and this created increased demand for aggregate resources in the cities. Since then many development projects have been established in different areas to draw people back to their rural homes. As a result of equal opportunities for education in the 1960s and 1970s, more people have been aspiring to middle class status, which consists of categories such as professionals, high-ranking public servants, teachers, businessmen, lawyers, accountants, and engineers. The changing role of women has also contributed to the development of some types of activities in the country, especially in terms of education and the way of life. According to Agnaia (1996), after the defeat of the Italians, and the occupation of Libya by Britain and France in the period after the Second World War, the condition of education in Libya was extremely poor. For example in Tripoli there were only 314 students and no female teachers at the primary level in 1943, but the numbers had increased to 2,923 by 1950 and female teachers were introduced into primary schools that year. Agnaia (1996) records that in the 1940s Libya was the most uneducated country in the world and until 1952 there were only ten Libyans holding BA degrees, while over 90% of the population were illiterate. However according to Deeb (1982), after Libya became independent in 1951, the Constitution set out to improve education by stating that:

- Every Libyan shall have the right to education.
- Teaching shall be unrestricted so long as it does not constitute a breach of public order and is not contrary to morality.

- Elementary education shall be compulsory for Libyan children of both sexes; elementary and primary education in public schools shall be free.

Since Libya declared the above articles on education, much has been achieved including the building of schools and training of teachers. The first Libyan University was founded in Benghazi on 15th December 1955, and by 1995, Libya had seventy universities and high institutes (NAID, 1995), although there was also a reliance on foreign universities. Nevertheless, Libyan schools and universities were responsible for preparing a large number of people to work in clerical and administrative posts in the private and public sector, and Table 2.3 provides statistical data that gives an overview of the inroads made in terms of education by the academic year 1995/96.

Table 2.3: Statistical Data about the Number of Students and Teachers in a Variety of Educational Levels during 1995/96 (Source: NAID, 1995)

The level	Number of students		Total	Number of Teachers		Total
	Male	Female		Libyan	Non Libyan	
Primary	744826	715617	1460443	135120	-	135120
Secondary	115374	135901	251275	16000	16516	32516
Institute of teachers	4470	19449	23919	1732	1500	3232
Vocational Education	81805	27269	109074	4645	3228	7873
Basic Vocational Education	12850	9640	22490	2850	950	3800
University and High Education	86580	78358	164938	2658	2909	5567
Total	1045905	986234	2032139	163005	25103	188108

From Table 2.3 the wide expansion of the number of students at all levels, especially in university and higher education is clear, as is the growth in female participation which represents 48.5% of the total number of students. It was realised that education had to be developed because of its effects on all other aspects of life, and in response, education policy in the 1980s concentrated more on vocational education, developing and evaluating the study materials according to human development needs. Improving school textbooks, libraries, preparing effective teachers and finding better education services in order to achieve the education process needs, were priorities.

2.7 Political Development

Events since the Great Al-Fateh Revolution in 1969 have seen the situation relating to environmental protection change dramatically. In the initial stages of development, when Libya's relations with the rest of the world were stable, many environmental programmes were provided by foreign companies, either by expatriates in Libya, or abroad at the foreign companies' headquarters. However, the imposition of UN sanctions brought changes in the political climate with the result that these types of relationship began to contract, such that vital links in the building of a proper environmental protection plan were lost. Consequently, despite the need to benefit from environmental initiatives in partnership with overseas countries, Libya has seen reduced commitment because of the political environment, and it is only of late that the position is becoming more relaxed.

2.8 Economic Development

Before the discovery of oil in 1959/60, Libya was a poor country and its prospects for economic development were very bleak. Agriculture was the basis of the economy and all domestic revenue. About 80% of the population was engaged in agriculture and animal husbandry, while the rest lived in a number of towns scattered around the country such as Tripoli, Benghazi, Sebha, and Misurata.

By the end of 1959, fifteen companies held petroleum concessions in Libya. American and British companies were responsible for exploration, drilling, production and exports and the companies employed a large number of Libyan workers, who developed advanced skills and techniques as a result of the training programmes offered by these companies. This well-trained, highly qualified and able workforce proved a valuable pillar for the success of the Libyan oil industry after the nationalisation of foreign oil companies and the creation of Libyan ones. In the years after the discovery of oil, the financial base of the Libyan economy changed dramatically and several profound changes occurred in the evolution of economic planning. The first five-year plans were to boost the Libyan economy and to remedy vital deficiencies, which affected the economic and social life of the country. Ten years later, Libya was already the fourth largest exporter of oil in the world, and the country's wealth increased rapidly, so that Libya changed from being one of the poorest countries in the world to one of the most affluent. Oil resources went from a situation of extreme deficit to one of considerable surplus.

Libya was still lacking in terms of skilled human resources, and planning administration and organisation. According to Naur (1986) this lack of skilled, educated Libyans for manpower made the country turn to foreign labour to underpin the industrialisation process. Workers from many countries, such as Egypt, Tunisia and Sudan, were encouraged to migrate in order to provide a workforce that would enable Libya to meet the objectives of its development plans. Most of the early projects in Libya had been realised by various foreign companies but these companies had nevertheless employed a considerable number of Libyan workers, and as they were given the opportunity to gain new skills, they were later able to become involved in the management of those projects they helped to create.

Fisher (1995) points out that the Libyan government achieved significant developments in its own projects in a short time. The aims of these projects were to achieve diversity of production, thus reducing dependence on the oil, to develop the economic and social infrastructure and to achieve a more equitable distribution of income and wealth.

2.9 Cultural Development

Arabic culture and Islamic rules are the most dominant elements in individual and group behaviour, social values, beliefs and attitudes, state law and political and economic policies. In Libya as in most Arabic and Islamic countries, family, religion and language have a huge impact on the attitudes and behaviour of people (Farley, 1971).

Additionally, because of Libya's position in the Arab world, many aspects of life have been influenced directly by Islamic rules, such as marriage, divorce and trade relations. As far as management activities are concerned, Islam brought a set of general guidelines that could be applied to management, relating to the organisation of human activities, individuals, group behaviour and responsibilities. For example, the Islamic conception of management consultation is to enhance the relationship between group members and their leaders. The manager is accountable to God and the people (employees), because the *manager is shepherd, and every shepherd is responsible for his people.* Islam requires people (employees) to carry out their tasks efficiently. The Prophet Mohamed emphasises this even further by saying "*Allah is desirous that when one does a work (job), he should make it perfect".* Therefore, these are essential issues for environmental protection development, requiring managers to discuss all work-related matters with employees, to encourage employees who do well, and to discuss problems with those who do not work well in order to help them to improve their skills, knowledge and ability.

Abuznaid, (1994), argues that religion has a great impact on human behaviour, social interactions and social relations. Islam as a religion and a way of life has an influence on the political, economic and educational system as well as other cultural aspects of Arab and Muslim societies.

The basic units of Libyan society are the extended family, the clan, the tribe and the village. Each of these plays a very important role in the individual and community's life and people's relationships with each other. Any individual in the Libyan culture is identified with his family; his good or bad behaviour even brings shame or fame to the family and the tribe. Moreover, factors of personal relations, kinship, family ties and collective solidarity play a major role in choosing or selecting leaders in the society instead of practical or academic qualifications. Also Libyan managers are more concerned about the creation of social relationships at the work-place than the job itself; and this leads to wrong people in wrong positions and promotion of managers, and directors not based on qualifications (Elfathaly, 1979).

The Libyan authorities issued many laws and regulations have set criteria of competence and academic qualifications. However, in practice some of these criteria may not be applied by the Libyan organisations due to social, cultural and general environmental differences that encourage selection of employees on the basis of personal relationships and kinship or tribe, as mentioned above, rather than efficiency and competence.

The planners in Libya do not link the society's needs with the country's plans; Agnaia (1996) suggested that the Libyan government should review their plans to comply with the business environment including social needs.

Government organisations' employees are influenced by society in many ways, e.g. implementing laws and regulations or developing new plans subject to the influence of family or tribe because the employees comply with what their families want them to do (Sakilani, 1999). Therefore the Libyan government organisation employees have more loyalty to their family and tribe than their organisations (Agnaia, 1996)

Agnaia (1996) opines that people working in government organisations do not follow the rules and regulations of their organisations, in order to satisfy others or ease some procedures for themselves. Therefore, administrative mistakes and errors have increased, which has led to a delay in achieving the organisation's objectives.

2.10 The Aggregate Industry

Aggregate resources sand, gravel, and crushed rock are the number one non-fuel minerals in Libya and the world in terms of volume and value (Masoud *et al.,* 1998). Aggregate minerals are essential materials in the construction of industrial development, building structures, runways, railways, roads for public transportation and dams. However, aggregate resources also represent a finite and non-renewable commodity. (Hora, 1988; Hora and Basham, 1985).

After the Great Al-Fateh revolution in 1969, urban development in the state of Libya has increased significantly especially in the housing sectors and road construction and that has created a great demand for aggregates in order to meet that demand. Over the past two decades the Libyan Government has granted a lot of permissions to open new quarries, which were mostly opened near urban centres where most of the population is concentrated (Masoud *et al.,* 1998). Consequently, the increase of quarry site numbers during the 1980s and 1990s was to secure aggregate materials needed without thinking of the environmental impacts created by those quarries.

2.10.1 The Libyan Aggregates Industry

Aggregate quarrying is an important sector and plays a vital role in the nation's economy, including major industries such as construction and house building, not only by providing essential materials but also by providing employment opportunities, often in rural areas. There are now hundreds of quarries in Libya producing sand and gravel, and crushed rock extraction extends all over the country especially in the north (Figure 2.4).

The Libyan aggregate industry is huge, ranging from large national or international companies operating throughout the country to smaller private companies (such as Al-Tashrokiat) based within Counties (Al-Shabiat) or local areas. These small quarries serve provincial towns and rural markets (Masoud *et al.,* 1998).

According to a study done by the Department of Geology University of Al-Jabal Al-Ghrbi in 1999, the Libyan Aggregate Industry has been developed very rapidly in the last decade and the aggregate extraction increased dramatically to meet all the demand for aggregate especially near urban centres. Some of the big urban centres such as Tripoli will soon experience aggregate shortages as local reserves are depleted.

The total number of quarries in Libya is about 411 operating all over the country almost 90% of which are active operations. As can be seen from Table 2.4 (see appendix 1) and Figure 2.5 there are about 264 quarries producing gravel and crushed rock, most of it in the middle and west of Libya. There are about 118 building stone quarries mostly in Azawia, Sabratah and Surman. Also there are about 29 quarries producing sand, gypsum and mud distributed all over the country (EGA, 2004b).

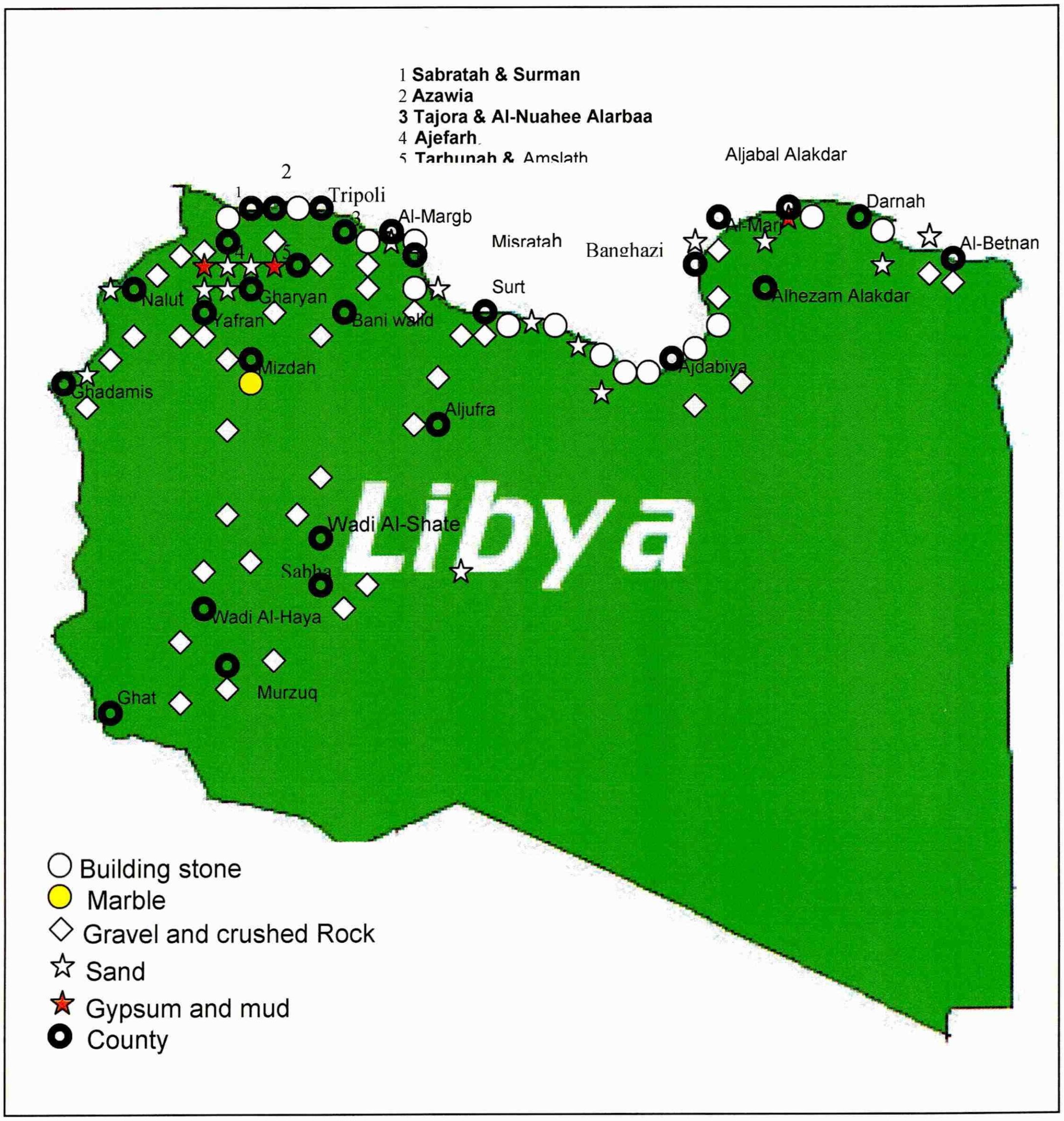

Figure 2.4. Showing the Libyan Quarries (EGA,2004b)

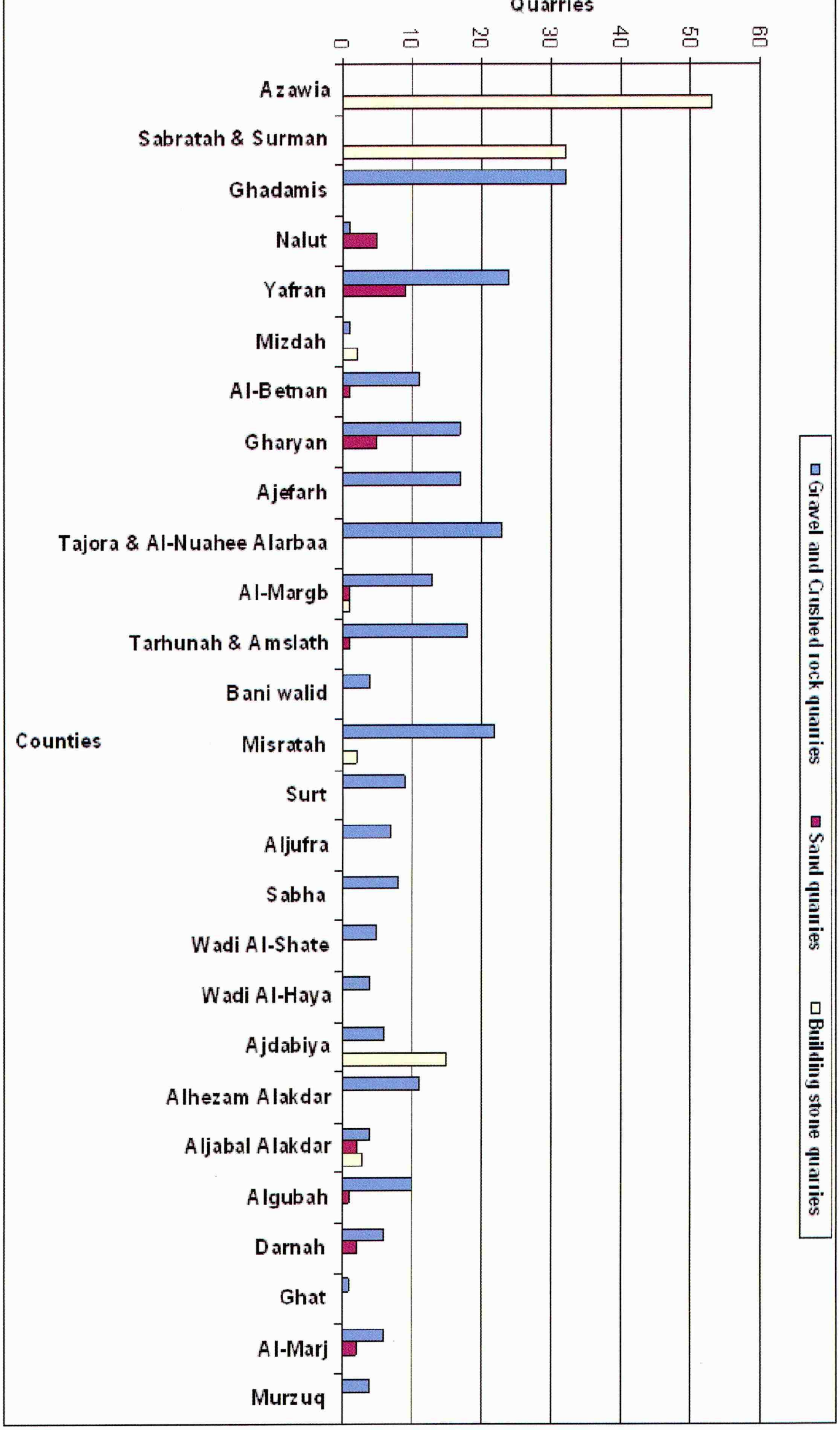

Figure 2.5. Showing the Libyan Quarries in Each County

2.10.2 The Demand for Aggregates

Aggregates are an important element of the national, regional and local economy in Libya. The total demand for aggregate mineral depends on the level of construction activity, which is determined by the state of the national economy and government policies (Thomas, 1986).

The Libyan government is interested in social welfare and has good financial ability to support it. The Libyan five-year plan (2000) stated that construction will be the major area of future economic development. The raw materials needed for construction such as sand crushed rock, gravel, clay, limestone, gypsum, and cheap fuel are found in abundant and commercial quantities adjacent to the major population and production centres in most of the country.

The production of aggregates increased rapidly After the Great Al-Fateh revolution in 1969 due to the high level of road construction, high number of housing projects and the starting of the Great Man Made River 1984. This is the largest underground network of concrete pipes in the world which will deliver fresh water from the south of the country to the major cities on the northern coastal strip and this requires a huge volume of aggregates. This explains why the numbers of quarries increased so fast to meet the demands in this project and other projects in the society.

According to the studies done by the Industrial Research Centre (IRC) in 1991, 1997 and 2003 (See Table 2.5) the primary aggregates are the only source of aggregates in Libya and overall production of aggregates has increased since 1991(Masoud *et al.,* 1998). From Table 2.5 (see appendix 1) and Figure 2.6 it can be seen that production of aggregates increased even more after sanctions were suspended in 1999. This growth is due to housing projects and building the railway network all over the country

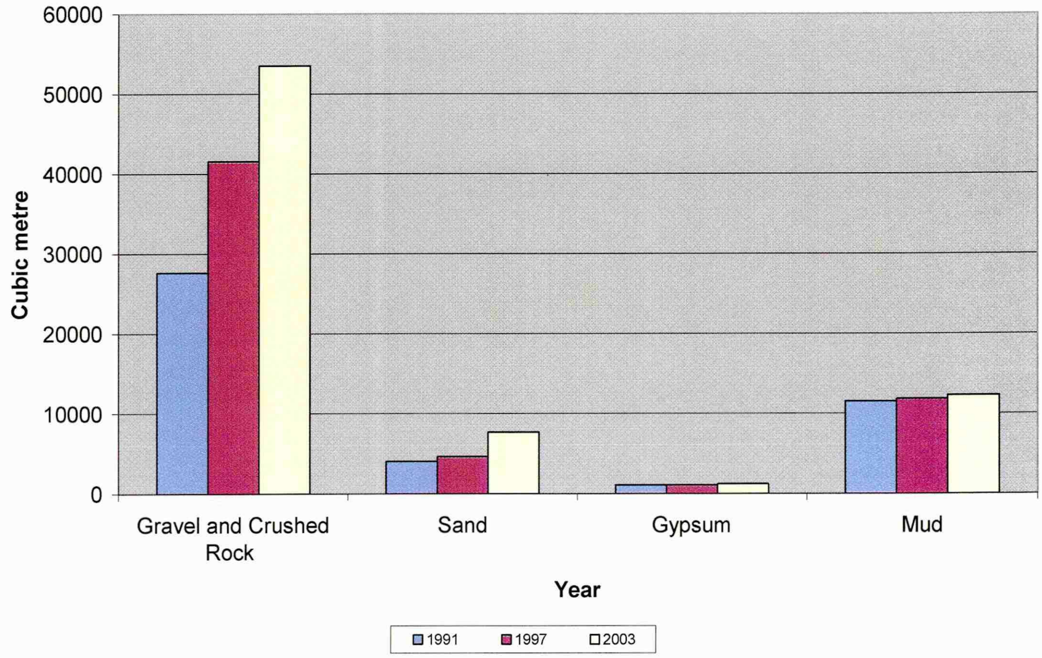

Figure 2.6 Showing the Aggregate Production in the Past 15 Years (IRC, 2003)

There are about 411 quarries in Libya distributed all over the country. Gravel and crushed rock is from about 264 quarry producing over 53508 cubic meters per day with an output valued at over 45,000 DL (Dinars of Libya) per day (See Table 2.6, appendix1). Building stone is from about 118 quarries with daily production of 631,400 building stones with an output valued at over 33,000 DL per day which is produced by small and national companies. The total number of sand, gypsum and mud quarries is 29 with daily production of 7671 cubic meters of sand (See Table 2.7, appendix1), 1230 tones of gypsum and 12320 cubic meters of mud with an output valued at over 25,000 DL per day see Figure 2.7.

The number of people working in the aggregate industry in Libya is about 8580 which comprises 3734 Libyan national labourers, 2246 Arabic labourers (Tunisian, Egyptian and Moroccan) and 2600 foreigner labourers (mainly other African countries) (IRC, 2003).

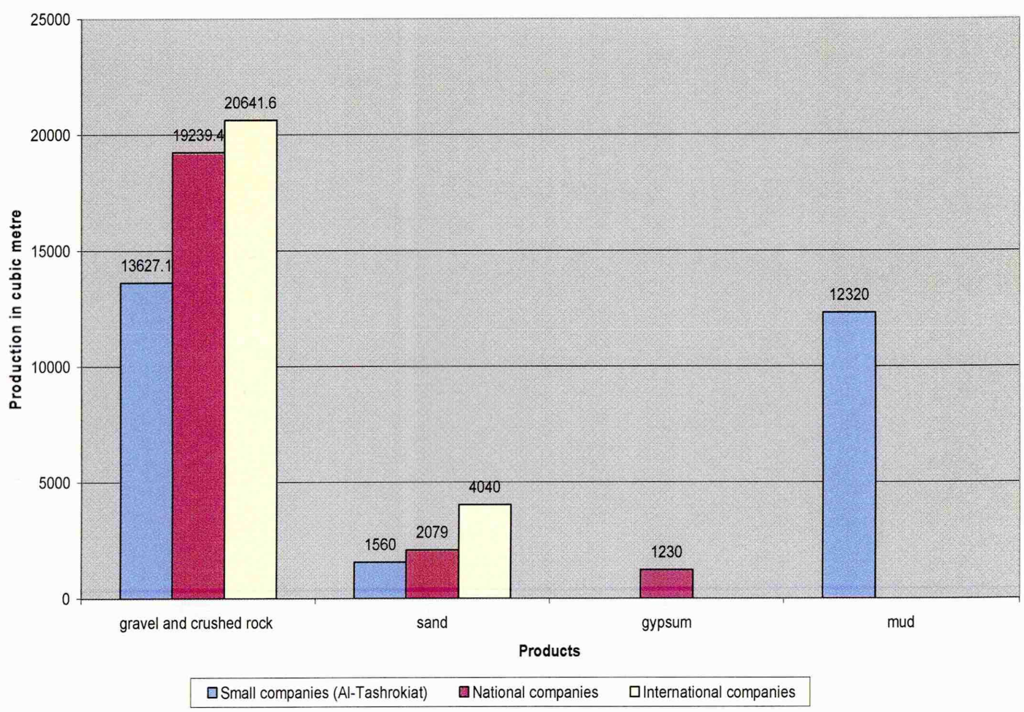

Figure 2.7 Showing the Daily Production of Aggregate in Libya (IRC, 2003)

2.10.3 Demand Forecasting for Aggregates

The demand forecasting calculation provides the opportunity for a steady and adequate future demand and supply of aggregate minerals in order to provide time to develop appropriate solutions to impending issues and possible aggregate supply shortages.

From the Figure 2.6 it can be seen that demand for aggregates has increased in the last 10 years and it can be assumed that it will increase even more in the future. Unfortunately the Libyan government does not have clear forecasts of future demand and supply of aggregates, so provisions to ensure adequate supplies will have to be made. The Libyan government will need to ensure an adequate and steady supply of aggregates at a national, regional and local level, also to maintain the supply at the best balance of social, environmental and economic cost, with full consideration of all resources and principles of sustainable development.

2.11 Environmental Planning Systems in Libya

Libyan Environmental laws and regulations aim to safeguard natural and human resources, preserving ecological balance, and minimising all sources of pollution. They also seek to meet development needs with environmental imperatives to protect natural elements (air, water, soil, biodiversity), reduce existing impacts to such resources and to improve the living conditions of the population. These objectives are presented in the national strategy for sustainable development in compliance with the principles of the Rio Conference (EGA, 2004b).

2.11.1 Libyan Environmental Institutions

There are different kinds of institutions in Libya concerned with the environment. They are led by the General Peoples Committee and the National Authority of Scientific Research, which is responsible for the conception, and implementation of a national policy of environment protection (EGA, 2004b). The Libyan Government has given environmental institutions a wide range of roles and responsibilities, such as aiding in implementing environmental laws and regulations, producing guidance notes to the industry and offering courses, seminars, leaflets and magazines etc... to help to improve environmental protection awareness (EGA, 2004a). These institutions are as follows:

2.11.1.1 The Industrial Research Centre (IRC)

The Industrial Research Centre is one of the early achievements of the Great Al-Fateh Revolution in the area of industrial development. The Centre was established by Act No. 25 of 1970 in the context of moving towards a national economic production based on sound scientific applications. The Industrial Research Centre through numerous studies, research and other scientific activities aims to improve the whole process of industrial development. The objective throughout this period, including a contribution of the capabilities to achieve the desired objectives of the liberalization of the national economy from dependence and foreign influence, and give IRC the ability to overcome obstacles that may stand in its way.

The most important roles for the IRC are:

- Identifying research priorities in the industrial field.
- Implementation of the research plans of industrial development.
- Preparation of feasibility studies for projects.
- Identification of the strengths of local raw materials and to identification of ways to exploit them.
- Raising the efficiency of industrial production.
- Study market conditions and the identification of the consumer in terms of their wishes and purchasing abilities.

- Environmental study and the identification of the positive and negative impacts on industrial activities.
- Collection and analysis of statistical data in the industrial field and making it available in the service of industry.
- Cooperation with similar research centres abroad and the exchange of experiences with them.
- Carrying out coordination and quality control.
- Testing and analysis for the benefit of industry and regulatory bodies.

2.11.1.2 The Environmental General Authority (EGA)

The Environmental General Authority was established by the resolution of the General Peoples Committee No 263 of 2000. In the face of increased risks to the environment and the necessity for an executive tool for the enforcement of environmental laws and regulations, the above mentioned resolution was issued, with sufficient powers to enforce the above in the manner defined by law, and required for public interest, in coordination with all relevant parties, following scientific progress in this field, and conducting related studies and research. The most important powers allocated to the authority as per Article Three provisions in its establishment resolution is that its objective is to protect the milieu in which man and all living organism live, including the protection of water, soil, air and food from pollution, and to exercise powers which had been given to the technical centre for environmental protection, and is substituted now by the environment general authority. This is stipulated in environmental protection law and its executive regulation, amounting to sixteen powers, the most important of which are the registration of all chemical substances that may cause environmental pollution including pesticide use for the public health, agricultural and veterinary purposes, defined by a resolution of the people's committee of the authority in addition to giving its opinion on the environmental effects of different projects, before proceeding to execute such projects, follow-up of agreements, conventions and international advances in the area of environment, etc (EGA, 2002).

2.11.1.3 The Centre of Building Material Research (CBMR)

This centre is under the supervision of the National Authority of Scientific Research and the main aim of this centre is to control the production of building material to make sure it is meeting the typical specification and is measured regularly to make sure that the product is high quality.

2.11.1.4 The Libyan Centre of Remote Sensing and Space Sciences

Satellite remote sensing data, in combination with field, laboratory, and theoretical studies, help characterize the geology, mineralogy, geomorphology, vegetation, and land-use patterns associated with current, reclaimed, and potential aggregate operations. This centre is under the supervision of the National Authority of Scientific Research and provides information on remote sensing, earthquakes, space sciences, environmental planning and geological maps etc.

2.11.1.5 The Division of Agriculture Police

The Agriculture Police were established by Law number 7 of the 1982 in regard to environmental protection. The agriculture police are responsible for protecting the green zone and agricultural areas from industrial development. The division is under the supervision of the Ministry of Agriculture and Rural Development.

2.12 The Libyan Regulatory Regime

In consideration of the importance of the environment, Libya has given it special priority and care, especially after the Great Al-Fateh Revolution which has taken numerous measures, and issued many laws to deal with current environmental issues, such as: soil erosion from overgrazing and other poor farming practices; desertification; dumping of raw sewage; petroleum refining waste; other industrial effluents leading to pollution of surface and groundwater. These laws explained and covered all legal aspects dealing with all of the various forms of pollution. They also aim to reconcile the requirements of development with the imperatives of the environment in order to protect the natural elements (such as air, water and biodiversity) and improve the living condition of populations and lessen the risks threatening these resources (EGA, 2004a).

The Libyan government gave environmental safety issues and control of pollution special attention and issued legislation regulating these different issues. There are various important laws in the Libyan environmental system dealing with most environmental impacts. These laws are:

- Law No 8 of 1973 in respect to prevention of oil pollution to sea waters. This law includes a set of rules and provisions for its application, the provisions of this law are limited to oil pollution sources. This comes from the equipment and machinery used in the aggregate quarries located on the coast line and also from ships etc...(Ministry of Industry, 1973a)

- Health law No 106 of 1973 and its executive regulation, which explained in detail all aspects of environment and environmental protection. The preamble dealt with the problem of water and its protection from pollution, which would be one of the main issues of aggregate quarrying, starting from the waste water used in the site, infiltration to ground water and extraction of material below sea level, causing sea water intrusion to ground water (Ministry of Industry, 1973b).
- Law No7 of 1982 in regard to environmental protection, and its executive regulation. This law is considered to be the most important law issued by the Libyan government in environmental protection. The aim of the law is to ensure that the habitat of man and all living creatures, including the air, water, soil and food, is protected from pollution, and to find appropriate ways of measuring such pollution with a view to the formulation of general plans and programmes to curb environmental pollution (GPC, 1982).
- Law No15 of 2003 in protecting and improving the environment. This law is more comprehensive for environmental protection and aims for sustainable development and as a starting point uses environmental impact assessment for all projects (GPC, 2003).

2.12.1 The Regulatory Regime and the Aggregate Industry

The most important legislations to the aggregate industry are Law No 2 of 1971 for quarrying and mining and the Law No 79 of 1970 to reorganise the mineral industry.

- Law No 2 of 1971 for quarrying and mining. This law aims to give the government organisation a comprehensive role to control minerals extraction and minimise its environmental impacts.
- Law No 79 of 1970 to reorganise the mineral industry. This law gives the Ministry of Industry the authority to control the minerals industry, by giving it a wide range of roles and responsibilities to control the investment of mines and quarries from opening to closure.

The previous two laws are the starting point by the Libyan government to control the aggregates industry. The main points of these are:

1. It is not permitted for an investor to choose the quarry site place without permission from a relevant department;
2. It is not permitted for an investor to produce the raw material without a plan from a relevant department;
3. The local authority must send inspectors to the quarry sites to check the work (such as aggregate extraction);
4. The investor must help the inspectors from the government organisations, who come to check the work regularly;
5. The investor must produce documents and reports about the work and the production value every six months, also the production should meet the requirements and standards specifications;
6. It is not permitted for an investor to extend a quarry or open new quarry near by without a permission from the relevant department;
7. The investor must comply with the environmental regulation, safety and health procedures.

8. After using the quarry or expiry of the contract, an investor must not leave the quarry without rehabilitating it.
9. The Ministry of Industry must ask for a financial guarantee from the investors to ensure the implementation of the environmental laws and regulations.

Attention to environmental issues in Libya has grown since the late 1980s, but during the 1990s environmental protection has shown no real improvement, this may to some extent be because of the UN sanctions applied in relation to the Lockerbie Issue. However since the sanctions were suspended in 1999 the Libyan government has taken number of steps to improve environmental protection and achieve sustainable development. These steps started with various amendments to its environmental laws and regulations such as producing Law No 15 of 2003 in protecting and improving the environment by the General Peoples Committee, which replaced Law No7 of 1982 in regard to environmental protection. On the other hand the Environmental General Authorities produced the guidance notes for the aggregates industry and that is the first guidance notes in the Libyan environmental regulations.

The Libyan Government has made modest attempts to achieve environmental protection, by encouraging people, companies, and voluntary groups to establish organisations and associations to deal with the environmental issues. This is under the Libyan government supervision organisation, called The Environmental General Authority. (Libyanonline, 2002)

2.12.2 Guidance Notes and the Aggregate Industry

The Environmental General Authorities (EGA) produces Guidance Notes to help for environmental protection. The EGA produced Resolution No 4 in 2004 as Guidance Notes for aggregate extraction to improve its work and to protect the environment (EGA, 2004A).

2.12.2.1 General Guidance Notes for All Quarries:

1. Permission must be obtained from the responsible organisations for environmental protection after submitting the environmental impact assessment of the proposed quarry and before getting permission from the other institutions;
2. The investment of the area must comply with the Law No 2of 1970 for quarrying and mining;
3. The investors must fulfil all the documents related to the quarry with the responsible organisations as required by the law No 2 of 1970 for quarrying and mining; such as environmental protection plan and development proposal that includes the end-use of the quarry site.
4. The equipment and the machinery used in the quarry must comply with environmental standards;
5. The investors must comply with the law No15 of 2003 in protecting and improving the environment and the traffic law by ensuring that vehicles are not loaded above their legal carrying capacity to minimize potential spillage in the public roads;
6. The investors must ensure that the materials in the trucks are properly sheeted before leaving the site;

7. The investors must create buffer zones and screen the site from the surrounding landscape by trees or mounds;
8. The area to change oil must be properly paved;
9. The investors must not use the quarry site as dump site and also keep the site clean from oil and fuel spills;
10. The investors must provide the workers with safety equipment;
11. The investors must provide reports showing how they had dealt with wastes.

2.12.2.2 The Guidance Notes for Gravel and Crushed Rock Quarries are:

1. The quarry should be placed outside the populated area, farming and animal land;
2. The sites area should not include any animals or plants close to it;
3. The area should not be reserved under special protection;
4. The area should be classified as industrial area by the responsible authorities;
5. Consideration must be taken to the wind direction and the extent of the impact on the surrounding environment;
6. The products must meet the standards specifications and also the products must be checked regularly to ensure the quality of the products.
7. Quarries should be placed far from the main roads to avoid the danger of blasting and dust;
8. The boundaries of the site must not be less than 200 meters wide.
9. The quarry must be placed in the middle of the area shown in the maps submitted in the permission;

10. The road to the quarry should be in good condition.

2.12.2.3 The Guidance Notes for Building Stone Quarries are:

1. The area should be classified as industrial area by the responsible authorities;
2. The quarry should put under regular technical tests to make sure that the product match so the standards specifications of the building material and test results should be put in archives;
3. The environmental impact assessment of the quarry should be authorized by the responsible office;
4. A permission must be obtained from the Environmental General Authorities before starting the work or applying a permission from other institutions to quarry the area;
5. investors must not invest outside the area specified in the permission papers;
6. It is not allowed to use old permissions to invest in a new area without obtaining a permission for that area;
7. The work should be stopped at least two metres above sea level and at a level which does not affect the ground water;
8. New technologies should be used to reduce dust distribution and the dust should not exceed 40-60 milligram in a cubic meter;
9. The road to the quarry should be in good condition all the time to reduce dust to the surrounding areas;
10. The investor must keep the waste materials away from the used area and not allow them to contaminate the surrounding areas;

11. The quarry must be placed away from populated areas , farm lands, and national parks with no less than 10km;
12. The permission to open a quarry is banned in the green lands, tourist places and areas under specific interest such as Juddiem Green area.

2.12.2.4 The Guidance Notes for Sand Quarries are:

1. The quarry sites must be placed away from the areas specified by the Beach Law, and the investor should produce the quarry map before obtaining permission;
2. Dredging or removing sand from the sea is banned;
3. The work must be stopped at least two metres above sea level;
4. The sand must meet the standards specifications before obtaining the permission;
5. The sand quarries outside the beach areas must not be dug below the normal land surface;
6. The investor must rehabilitate the quarry after finishing the investment.

By reviewing the Libyan regulatory regime it can be said that the environmental laws and regulations could reduce the environmental impacts in the aggregates industry if well implemented and followed by industry and the government organisations.

2.13 Environmental Impact Assessment in Libya

With the exception of some oil companies, all Libyan companies, organisations and activities are lacking in environmental procedures, environmental protection and sustainable development. This is mostly because the ideas and concepts relating to environmental issues were neglected following the UN sanctions after 1992. Most of the world has been addressing environmental problems step by step after the 1992 Rio World Summit which Libya did not attend. Since sanctions were suspended in 1999, the EIA regulation and the national environmental strategy in Libya are in progress and development has occurred in health provision, countryside and wildlife protection, greenhouse gas reduction, water consumption guidance and waste disposal dumping (Elbah, 2002).

The law No 15 of 2003 requires that all major developments with a potentially significant impact on the environment are subjected to environmental impact assessment to predict the impacts of the proposal to biological, social physical and cultural environment.

The Libyan planning system since 2003 requires appropriate level of environmental impact assessment dependent on the size of the site and type of proposal, in accordance with the environmental legislation and any other relevant provisions (EGA, 2004b). But this law applies only to new quarries and does not include quarries started before the Law No15 of 2003.

2.14 The Procedures and Requirements to Open a New Quarry

The Libyan Mining and Quarrying Procedures, 1984 presented the procedures to open a new quarry in Libya (Figure 2.8) as follows:

1. The investor must have permits from the Agriculture Administration to declare that the land is not appropriate for farming.

2. The investor must have permits from the Electricity Company confirming that there are no underground cables or any future plans to develop electricity network through this land
3. The investor must have permits from the Transportation Administration to declare that there are not any types of routes or motorways or railway networks that will cross this land
4. The investor must have permits from the Regional Municipality confirming that there are no plans to establish a new community on the selected land and also that there are no water pipelines planned to cross the land (Elbah, 2002).

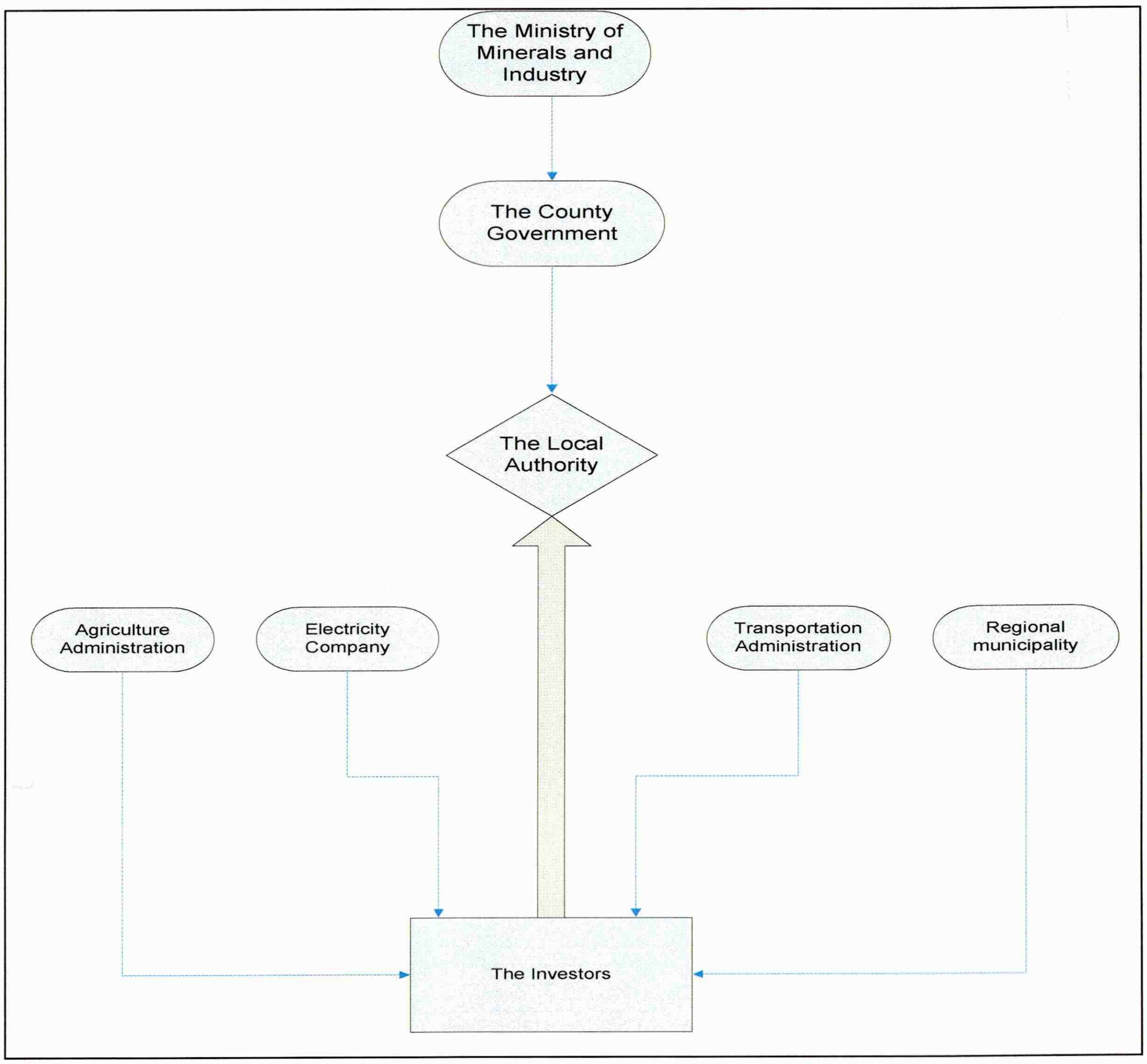

Figure 2.8 Model Showing the Procedures to Open New Quarry in Libya (Source Ministry of Industry, 1984)

The licence procedure to open new quarry in Libya is very weak and does not include an EIA report or environmental permission because it has been set out according to the law No7 of 1982 in regard to environmental protection. So the licence procedure needs to be improved to comply with industrial development.

2.15 Chapter Summary

This chapter has discussed the Libyan environment and in doing this it has referred to social and industrial development, and the influences upon these developments of traditional Libyan culture. In more specific terms, the early sections in the chapter highlighted the social, political, economic, and cultural aspects of Libyan society in which the case studies of this research have evolved. From what was displayed in this chapter, the Libyan culture, which is part of Arab culture, still encourages loyalty to family, clan, tribe and personal relationship. These kinds of relations have a negative impact on implementation of environmental laws and regulations in the Libyan Aggregates Industry. Also, this chapter discussed the Libyan Aggregates Industry and the Libyan planning systems and the Libyan environmental organisations.

The Libyan government gave environmental issues and control of pollution special attention especially in the last ten years, by taking a number of steps to improve environmental protection and achieve sustainable development. Those steps started with various amendments to its environmental laws and regulations aimed to safeguard natural and human resources, also preserving ecological balance, and minimising all sources of pollution. The other step was establishing a number of environmental institutions and giving them a wide range of roles and responsibilities, such as aid in implementing environmental laws and regulations, producing guidance notes to the industry and offering courses, seminars, leaflets and magazines etc... to help to improve environmental protection awareness.

A section in this chapter has been written to define the Libyan regulatory regime and its relation to the aggregates industry and presenting the most important guidance notes issued to the aggregate industry. At the end of the chapter the procedures and requirements to open a new quarry were discussed.

The next chapter (Chapter Three) will give comprehensive review to the aggregates industry in the world and the UK aggregates industry in particular.

CHAPTER THREE

Chapter Three
The Aggregate Industry-an international Overview

3.1. Introduction

This chapter has been divided in two parts; part one reviews the Aggregate industry in general starting from aggregate definition and types to the life cycle of the aggregate site. Part two reviews the UK aggregates Industry in order to use the UK experience in this field to suggest improvements to the Libyan Aggregates Industry.

Quarrying is the process of digging into the earth to extract naturally occurring minerals such as sand, gravel and rock. The aggregates minerals are at the core of today's civilised world that we live in. The industrial development relies in one way or the other on the aggregates industry, any country in the world requires large supplies of aggregates for the construction industry. Therefore quarrying must be carried out in the process of trying to satisfy that demand. Aggregates (crushed rock and sand and gravel) are extracted for use in construction activities such as roads, homes, bridges, etc. Most quarrying is at the surface. In surface quarrying, after blasting with explosives (if necessary), workers use earthmoving equipment, such as power shovels, draglines and power scrapers, to scoop off the layers of soil and overburden covering the mineral bed. Once the aggregates are exposed, smaller shovels are used to lift it from the ground and load it into trucks for processing or delivery to the market (U.S. Department of Labour, 2005).

Natural aggregate, consisting of crushed rock, sand and gravel, which are fundamental to manmade structures and the construction industry, use large quantity of these materials. That is why the quarrying industry plays a vital role in the nation's economy, not only by providing essential materials but also by providing employment opportunities mostly in rural areas (Ricketts, 2001).

Re-use of aggregate is now becoming a more common practice. The substitution of natural aggregates by artificially made waste products of other industries is a small part of the industry (Smith *et al.,* 2001). Natural aggregates are formed by the process of weathering and the artificial ones by crushing a large parent mass. Building materials are non renewable, i.e., they do not grow again nor are they replaced. In urban areas, where the demand for aggregates is greatest, obtaining good natural aggregates at reasonable cost can be a considerable problem. When aggregate sources outside an immediate construction area must be used, transportation costs may double or triple the selling price (Ricketts, 2001).

3.2. Aims and Objectives

3.2.1 Aims

The main aim of this chapter is to review the aggregate industry in general and to give a brief introduction to the UK aggregates industry which includes review of the development of legislation relating to the environmental effects of the aggregates industry.

3.2.2 Objectives

1. Review the aggregate industry in general, which includes aggregates definitions and types, the economic importance of the industry and the life cycle of the aggregates site.
2. To review supply and demand of aggregates in the UK since 1950.
3. To review the development of UK environmental legislation during the last fifty years.

3.3. Aggregate Definitions and Types

"The term aggregate originally derived from the Middle English aggregat in the 15th century, which derived from Latin aggregatus, past participle stem of aggregare "to add to," literally "to bring into the flock," ultimately from the stem greg- "flock". As the name indicates, aggregates are rock fragments that are together in a mass" (Christie et al, 2001).

The term "aggregate" has been defined by number of authors, The British Geological Survey (2002) defined aggregates as a "*term used to describe granular or particulate material, either naturally occurring (sand and gravel) or produced by crushing (crushed rock). This is suitable for use in construction as concrete, road stone, asphalt, constructional fill or railway ballast*".

Smith *et al* (2001), defined aggregates as "*the particles of rock which when brought together in a bound and unbound condition form part or whole of an engineering or building structure*".

The American Society for Testing and Materials (ASTM, 1980) defined Aggregate as a "granular material of mineral composition such as sand, gravel, shell, slag, or crushed stone used with a cementing medium to form mortars or concrete, or alone as in base courses, railroad ballast, etc" (ASTM, 1995).

Aggregates are an essential ingredient for the construction industry; they may be natural (primary), artificial (secondary) or recycled.

1. Primary or natural aggregates are aggregates produced from naturally occurring mineral deposits and used for the first time. The majority of construction aggregates are produced from naturally-occurring particulate deposits such as sand and gravel or from hard rock formations by crushing to produce crushed rock.
2. Secondary aggregates are aggregate obtained as a by-product of other processes, including other quarrying and mining operations e.g. china clay waste or by-product of other industrial processes e.g. slag.
3. Recycled aggregates are aggregates resulting from the processing of inorganic material from various sources previously used in construction such as concrete, demolition waste and civil engineering works (Oldershaw, 2003).

3.3.1 Types of Aggregates:

An aggregate particles size is most often determined by a sieve analysis (Figure 3.1). In a sieve analysis, a sample of dry aggregate is separated through scaled sieves with progressively smaller openings. The American Society for Testing and Materials (ASTM, 1980) divided aggregates to different types as follows:

a. Coarse aggregate: Designation given to larger aggregate that will pass the 19 mm screen and predominantly retained on No.4 (4.75 mm) Sieve.

b. Fine aggregate: Designation given to the smaller aggregate passing the 9.5 mm sieve and almost entirely passing 4.75 mm (No.4) sieve and predominantly retained on the 75-µm (Micrometer) (No. 200) sieve.

c. Open graded aggregate: Designation given to the aggregate that has only small percentage of aggregate particles in the small range as a result the voids between aggregate particles remain relatively large because there are not enough small particles to fill in the voids between the larger particles.

d. Dense graded aggregate: Designation given to the aggregate that has a particle size distribution such that when it is compacted, the resulting voids between the aggregate particles remain relatively small.

e. Soil aggregate: Natural or prepared crushed mixtures consisting predominantly of hard particles or fragments of rock, gravel, sand or slag which contain a significant amount of silt-clay conforming to specified requirements.

f. Gap grading: Designation given to material when one or more of aggregate size in a normal downward distribution of aggregate particle sizes are wholly or substantially absent, hence producing a "gap" in the grading where there is little or no aggregate of a particular size to be found.

g. Continuous grading: A particle size distribution in which intermediate size portions are present as opposed to gap-grading.

h. Concrete: A composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate which are usually a combination of fine aggregate and coarse aggregate; in hydraulic-cement concrete the binder is formed from a mixture of hydraulic cement and water, (ASTM, 1994).

i. Rubble: Designation given to irregular fragments of rock broken from a larger mass of rock either naturally or artificially, as by geological action, in quarrying, or in rock cutting or blasting.

j. Chips: Designation given to small angular fragments rock containing no dust.

The physical properties of Aggregate have a direct effect on how an aggregate performs as concrete, pavement material, and roadway, and also by itself as a base or sub-base material. So the use of aggregates is determined by its particle size, shape, gradation, and particle strength, because grading and particle size affect the amount of aggregate used and on what the material is to be used for (Marotta, 2002).

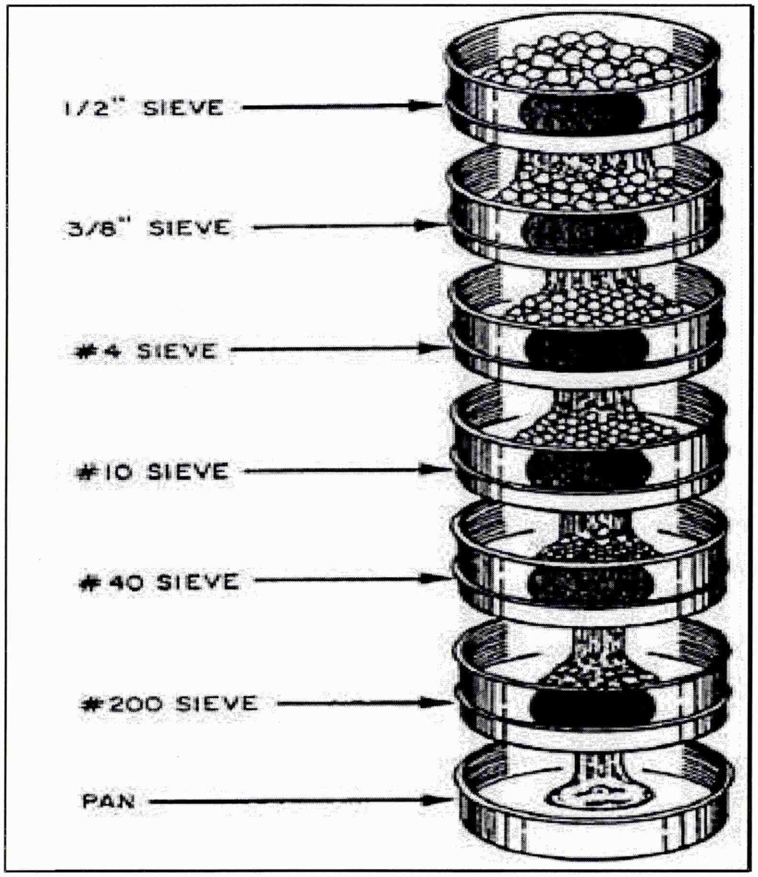

Figure 3.1 Sieves Used for Gradation of Aggregate.
(Source: Integrated Publishing, 2006)

3.4. Aggregate Origins and Production

Aggregates can either be natural or manufactured. Natural aggregates are generally produced from naturally occurring rock formations and sand and gravel through an open pit (quarry) (BGS, 2005b). Crushed rock is usually produced from hard rock, such as igneous rock by drilling and blasting the rock from the quarry walls then go through a series of screening and crushing to reduce the rock into different sizes. Sand and gravel is commonly formed by natural erosion of existing rock and surficial deposits including the transportation and deposition of the eroded particles. The major sources of sand and gravel aggregate commonly occur as stream-channel, terrace, glaciofluvial and alluvial fan deposits. Some quarries wash the finished aggregate before send it to market (Langer, 1988).

Manufactured aggregate are generally produced from industrial by-products not used in construction before such as metallurgical slag which is produced from processing steel, tin and copper or by-products from other industrial processes such as china clay, slate waste or from other rock produced that has a particular physical characteristic not found in natural rock such as lightweight aggregate (BGS, 2005b).

3.4.1 Natural aggregates

Natural aggregates are commonly produced from older, more compact sedimentary formations, particularly limestone and sandstone, from igneous and metamorphic rock masses and from naturally occurring concentrations of particulate deposits, such as sand and gravel and conglomerate. Gravel is small rounded stones of different sizes which are generally obtained as such from river beds. Sand is the fine aggregate formed by weathering of rock (BGS, 2005a).

3.4.1.1 Crushed Rock

Crushed rock is the first source of natural aggregate. Crushed rock is obtained by drilling, blasting a quarry face and then loading it into trucks, and transporting the rock to a facility where it is crushed, screened and washed to produce a wide range of aggregates in various sizes and to specified quality limits (Langer *et al*, 2004)(Plate 3.1 a&b). There are three basic types of rock used to produce most crushed rock aggregates.

1. **Igneous rocks:** A type of rock which formed as a result of volcanic activity from magma or lava that erupted from deep within the earth and then solidified to become rock such as granite, basalt, andesite, or gabbro

2. **Sedimentary rocks:** A type of rock which formed by consolidation of sediments in the distant past, by chemical, organically, or mechanical processes. There are different types of rock formed by these processes such as limestone, chert and dolomite (chemical), sandstones and shales (mechanical), and marl (organic).

3. **Metamorphic:** Metamorphic rocks are formed when other kinds of rocks (sedimentary rock, igneous rock or another older metamorphic rock) are changed by great heat and pressure inside the earth; e.g. quartz is formed by the action of heat and or pressure on existing rock formations. The physical characteristics of metamorphic rocks vary widely. Some examples of metamorphic rocks are slates, schists, granite gneiss, marbles, and quartzite (Brian *et al*, 1987).

3.4.1.2 Sand and Gravel

Sand and gravels are the second major source of aggregates, which are accumulations of durable rock fragments and mineral particles (Langer *et al*, 1995). Sand and gravels are generally formed by erosion of bedrock and then transported by rivers or ice to be deposited in riverbeds that or into the sea. Excavation is from dry pits or fossil or recent river beds do not require blasting to loosen the resource. It is normally performed by hydraulic excavators, mechanical shovels and front end loaders (Plate 3.2).

Plate A

Plate B

Plate 3.1 a&b Tunstead Limestone Quarry Peak District Derbyshire England, Taken By the Author July 2005.

Deposits mined below the water table, including marine, river beds, stream and lake-bed deposits may be excavated by specialised equipment such as draglines, or from barges using hydraulic or ladder dredges (Langer *et al.*, 2004).

3.4.1.3 Manufactured Aggregates

Natural aggregate occurs where nature placed it and may not be available where it is needed. Manufactured (secondary) aggregates are an important source of aggregate in such cases. The secondary aggregates are processed from various sources including construction of buildings, engineering works, resurfacing roads and demolition sites (BGS, 2005a).The quality of the secondary aggregate dependents on three factors:

1. The quality of the materials that are processed,
2. The selection and separation processing used, and
3. The degree of final processing that these materials undergo.

The secondary aggregates produced by two methods, first in situ at the site of the arisings, second ex situ in a central plant. The first method is more economical due to saving of transport costs and the accrual of the environmental benefits of reducing lorry movements (Wrap, 2006).

3.4.1.4 Dredging Aggregates

In the last three decades aggregate dredging has increased. This could be due to the improvement of the dredging technology and the expansion of marine aggregates markets (Smith *et al.,* 2001). Dredging activity involves removal of large amounts of sand and gravel from the sea bed and this affects the marine environment. Marine aggregate is excavated by specialised equipment such as draglines, or from barges using hydraulic or ladder dredges (Plate 3.3).

Plate 3.2 Sand quarrying (Sand Quarry Storrington West Sussex, England)
(Source: Richard, 2002)

Plate 3.3 Marine Dredging,
(Source: Quarry Products Association, 2006)

3.5. Economic Importance of Quarries

Construction aggregates are basic materials for the construction industry. Aggregates are an essential input to the construction industry; without aggregates there would be no highways, houses, schools, sewers or water pipes.

Aggregate extraction plays an important part in urban development, providing a source of employment and a supply of basic materials for construction, agriculture and other forms of economic development (Highley *et al,* 2004). The direct contribution of the aggregate industry to the economy in terms of value and employment is relatively good especially in rural areas and helps to maintain a well structured rural economy with a diversified skill base (Masoud *et al.,* 2006).

The importance of the aggregate industry to the economy is not attributable only to the production value or to the number of people employed directly or indirectly in the industry. Aggregate minerals are also essential materials to a large number of industries which make larger contribution to wealth creation and employment in any country, for example, limestone used in construction, sugar factories etc (BGS, 2004).

Aggregate minerals are the lowest priced of all mined mineral products and the cost of transportation from the site to the point of use is estimated to be approximately 60% of the total cost of aggregate. Therefore, assessing the economic value of an aggregate deposit depends not only on the quantity and quality of the deposit, but also how close the deposit to its final destination (US, Department of the Interior, 2005b).

3.6. The Stages of Quarrying

The extraction of aggregate (rock, sand and gravel) involves a sequence of activities, starting from the search for mineral deposits through to end use of the site, all of which have environmental implications.

The methods of extracting rock, sand and gravel differ widely and depend on the location, type and size of mineral resources. Surface mining operations are more economic in situations where Aggregate deposits occur close to the surface (e.g. sand mining) (Fuggle *et al.*, 1996). The surface mining operations can be broadly classified as quarry, open pit or strip mining, dredging and hydraulic mining in riverbeds. All these activities have a wide range of environmental impacts such as effects on fauna, flora, water and landscape (Ashton, 1999).

When rock, sand and gravel lies at a depth where the cost of removing the overburden is expensive, the resources are extracted by underground mining operations. A variety of techniques are used in underground mining, such as block caving and long-wall mining. Underground mining requires good infrastructure to ensure mine safety and safe working environments for the miners. (Ashton, 2001).

The environmental impacts of surface and underground mining are distinctively different. Surface extraction always has a disruptive impact on soils, fauna, flora, land use, water and the landscape mainly due to the removal of the overlying vegetation, soil and rock. Surface extraction is usually less expensive and more productive than underground mining (Fuggle *et al.*, 1996; Ashton, 1999). The new surface extraction technology has allowed surface mining to be favoured even in situations where underground mining would be feasible, because it permits complete access to the ore deposits and also surface mining is less dangerous to the safety and health of the mine workers (Brink *et al.,* 1990). The considerable danger of collapse or explosions in underground mines does not exist in surface mines (Lacy, 2003). Although, of course slope failures can occur.

Aggregate extraction is mostly surface mining and its environmental impact will be discussed in the next chapter (Chapter Four).

The typical life cycle of a mining operation generally progresses through seven stages and activities as follows:

1. Prospecting, or the search for mineral deposits;
2. Exploration, or the work involved in assessing the size, shape, location, and economic value of the deposit;
3. Development, or the work of preparing access to the deposit so that the minerals can be extracted from it;
4. Exploitation, the work of extracting the minerals;
5. Transportation to processing or market;
6. Processing;
7. Restoration.

3.6.1 Prospecting:

Prospecting is the first stage in most mining programmes and is the process of recognising, evaluating and identifying new areas considered to have potential for hosting economic mineralization (Howard *et al*, 2002). Prospecting involves the detailed examination of land surface and underlying bedrock in search of an economic mineral deposit, or evidence of the nearby existence of a mineral deposit, utilising geological, geochemical and geophysical tools (Carlson, 2005).

3.6.2 Exploration:

Mineral exploration includes all activities used on or underneath the land surface for defining and gaining knowledge of the size, shape, location, quality and quantity of economic concentrations of minerals deposits within the Earth's crust (Howard *et al*, 2002). In the exploration stage there are numbers of methods which can be used to explore and evaluate mineral deposits; the techniques used in exploration and prospecting are similar but in the exploration stage are more refined. Geological and geophysical surveys, boreholes and trial pits are the main methods used in the exploration stage (US, Department of the Interior, 2005a).

3.6.3 Development (Site Preparation)

Site preparation and evaluation consists of:

1. Removal or Stripping the overburden, which is plants, trees, soil and rock to reach the ore deposits;
2. Transporting and storing topsoil and overburden for restoration;
3. Constructing fences, access roads, offices, buffer zones, mineral transportation systems and other support facilities;
4. Constructing or installing permanent or portable processing facilities and power sources (PQU, 2002).

3.6.4 Exploitation (Extraction)

Exploitation (extraction) is the recovery of mineral from the earth. Exploitation of minerals can be sub-divided into two basic methods, surface and underground. The method used in the exploitation of minerals depends on the particular mineral, characteristics of the deposit, environmental concerns and the location of the deposit, and also the geologic conditions play a key role in selecting the method. (Howard *et al.*, 2002) As stated above, in the aggregates industry, most mining is surface mining. There are a number of different surface mining techniques that can be applied to extract the material, its use depending on the physical characteristics of the raw material and on the site-specific situation.

3.6.5 Transportation to Processing or Market

Transportation is an important part of surface mining extraction because transportation determines both the price of aggregate and the location of quarries. The extracted material can be transported twice, firstly within the site from the quarry face to processing and secondly from the site to the market (US, Department of the Interior, 2005a).

The extraction and transportation of crushed rock, sand and gravel for processing are performed generally by mechanical shovels and front-end loaders. In most cases rock, sand and gravel are transported by haulage vehicle such as a truck, but railroad track-type car or pipelines can be used as well to transport the material from the quarry face to a processing plant, or directly into a primary crusher. Large numbers of trucks are used at most quarry sites to transport the material from the quarry to the primary crusher (PQU, 2002).

The different types of transportation and its availability have a major impact on the location of production. Quarries located on, or near major transportation routes are often able to reduce transport costs and be competitive in more markets.

The transportation of aggregates to the point of use is a major factor in the delivered price of aggregates (Wilburn *et al,.* 1998). The method of transportation is determined by cost and availability of transportation methods, truck haulage is the most common mode of transporting aggregate and it is the economic and preferred choice for distances up to 50 km. Although trains and barges are used, when the aggregate sites have access to rail connections, rail haulage is often used for intermediate distances of 50 km to 100 km. When water access is available to aggregate sites, water transport by barge or marine vessel is becoming more common for very long haulage, generally over 100 km (Christie *et al*, 2001).

3.6.6 Processing

Processing of aggregates after their extraction involves series of crushing, screening and washing stages designed to produce aggregates with a specified range of sizes to suit customers' needs. Processing of rock and sand and gravel are different; rock quarry material is processed in three stages, firstly the primary crusher roughly crushes material; secondly crushers reduce the aggregate size and thirdly crushers produce the final size and shape of aggregate products. In a sand and gravel quarry the process is simpler and involves two stages, firstly washing and sizing of material, and secondly crushing the oversized gravel particles (BGS, 2005b).

Aggregates are mostly processed wet, both to minimise dust impact and to remove deleterious materials such as clays. Processing plants for large and medium operations are generally fixed, mobile or temporary plants may be used for relatively short life of sand and gravel operations, small quarries or short-term construction projects. A typical fixed plant would be located near an urban area in quarries with larger reserves and an extended life supplying a variety of markets. (Christie *et al*, 2001).

3.6.7 Restoration

The final stage in the aggregate operation is restoration, which has been defined by the British Geological Survey (2005b) as "*Returning the land used in quarrying to some previously agreed purpose. This may be for use by landfill, agriculture, wildlife or as a new public amenity such as parkland or water sports*". This will involve the removal of contamination, the making safe of dangerous structures and the bringing of the site into a condition fit for a future use. The restoration should be planned before the start of the quarrying work in order to meet the philosophy of sustainable development (Howard *et al.*, 2002).

3.7. The UK Aggregate Industry

Minerals are non-renewable resources that can only be worked where they are found and mineral extraction by its nature can have a major environmental impact on land and on communities. There is a wide range of surface mining activities in the UK, mainly for coal and other minerals and, in particular, quarries for the production of construction aggregates (Morgan, 2003).

During the industrial revolution, the affects of mineral extraction on the environment were not understood or were ignored. As a result, the environment of Britain was damaged, and generations suffered from the effects of air pollution, water pollution, noise, and other environmental problems. Over the last three or four decades, environmental legislation, an effective enforcement regime and a range of appropriate technologies have been developed to address these issues in the UK (The British Council, 1998). During the twentieth century, environmental controls have been gradually extended, as the government and local authorities have realised that something had to be done about the impact on the environment of mining and quarrying of aggregate minerals.

The UK Aggregate Industry is one of the oldest industries in the country with currently about 412 active rock quarries and 501 active sand and gravel quarries and about 60 marine wharves throughout the UK. The industry extracts around 250 million tons of material per year to provide the construction industry and societies needs with necessary material for building houses, roads, hospitals and schools etc... The aggregate industry contributes around £3bn to the GDP and provides employment for around 41,000 people, mostly in rural areas (NSC, 2004).

There are more than 100 operating companies in the UK ranging from large publicly owned multi-national companies operating quarries throughout the country (Table 3.1), which together account for 85% of total production, to smaller private operators (often referred to as 'independents') based within a state or county area, serving small towns and more remote rural markets (NSC, 2004)

Company name	production	Sites	Employees	Based
Tarmac Ltd	UK's largest aggregates producer	700 sites in the UK	10,000 employees in 11 countries	UK
Hanson plc	World's largest aggregates producer and second largest in UK	400 sites in the UK	28,000 employees all over the world. About 7,500 employees in the UK only	UK
Lafarge plc	one of the World's largest producers of aggregates and cement	200 sites in the UK	80,000 employees in 75 countries. About 2,000 employees in the UK only	UK
RMC Ltd	4th largest aggregates in the World. one of World's largest concrete producers; major cement producer	125 sites in the UK	30,000 employees Worldwide	UK
Aggregate Industries plc	one of the leading aggregates producers in UK and US		9,000 employees	UK
Foster Yeoman Ltd	Aggregates producers		700 employees	UK

Table 3.1 Shows The Six Main Multi-National Companies Producing Aggregate In The UK. Source (NSC, 2004).

3.7.1 Demand for Aggregates in the UK

Aggregates are an important element of the national, regional and local economy. The total demand for aggregate minerals is related to the level of construction activity, which is determined by the state of the national economy and government policies (Thomas, 1986). At the turn of century, Britain was using around 2 million tonnes of aggregates per annum (mtpa) – a figure which had risen to 57 mtpa just after the Second World War. However by 1973 consumption had reached 276 mtpa. From Figure 3.2 and Table 3.2, it can be seen that overall production of aggregates increased markedly in the post-war period.

During the period 1950-1970 almost all demand for aggregates was met by natural deposits on land, with only a small amount coming from marine or manufactured aggregates (DoE, 1975a). The production of aggregates increased rapidly between the 1950's and the late 1980's, in large part due to the high level of road construction activities. Since the 1970s, aggregate production from marine, recycled and secondary aggregates has increased slightly, especially during the 1990's (DoE, 1994), but natural land deposits remain the major source of supply of aggregates in the UK.

Although the Government and planning authorities recognise the importance of aggregates to daily life, they are also aware of the environmental impacts of quarrying. As such, they must make sure that the supply of aggregates continues to meet the needs of society, but not at the cost of major environmental damage and disruption (DoE, 1988).

Concern was expressed in the 1970's that, unless other supply solutions were found, almost all the gravel-bearing land in the South East region which was not agriculturally valuable or environmentally precious would be worked out by the early 1990s (Blunden, 1975). Despite this concern, demand in Britain continued to rise and by 1989 production of aggregate reached a peak of 304 million tonnes (BGS, 2002b). Demand has subsequently fallen back slightly, possibly as a result of economic recession and its effect on the construction industry, the decrease in road building over the last 10 years, and the increase in the use of recycled material as secondary aggregates.

3.7.2 Demand Forecasting for Aggregates

Since the beginning of the 1970s, there has been considerable concern as to how the longer term demand for aggregates might be met. The demand for aggregates puts planning authorities under pressure to release more land for aggregate extraction. The Verney Report (DoE 1975a) represented a significant attempt by government to address this problem in the mid-1970s. The Verney Committee recommended that the government should set up the Regional Aggregates Working Parties (RAWP's) to provide both qualitative and quantitative information on all aspects of minerals planning, including changes in demand, technology and environmental standards. It also recommended that demand forecasts should be based on a wide ranging analysis of past trends in the construction industry together with carefully thought out assumptions on the future development of the industry. Forecasts should not rely too heavily on sophisticated statistical analysis and should not be projected to an unreasonable extent in the future (DoE, 1975a). As a result, a regular system of demand forecasts was instituted with regional forecasts produced every 4 years. Furthermore, the potential for interregional trading in aggregates was examined in detail.

The results of these surveys carried out by the Regional Aggregate Working Parties were used by the government to frame national guidelines for aggregates provision in England and Wales. The guidelines were published in

1982, and were developed primarily for land use planning for aggregates (Williams, 1986). During the 1990's, the guidelines were expanded to assist the development of aggregates policies and reduce environmental impacts of mineral working, while at the same time providing a steady supply of aggregates to the construction industry at the optimum level of social, economic and environmental costs.

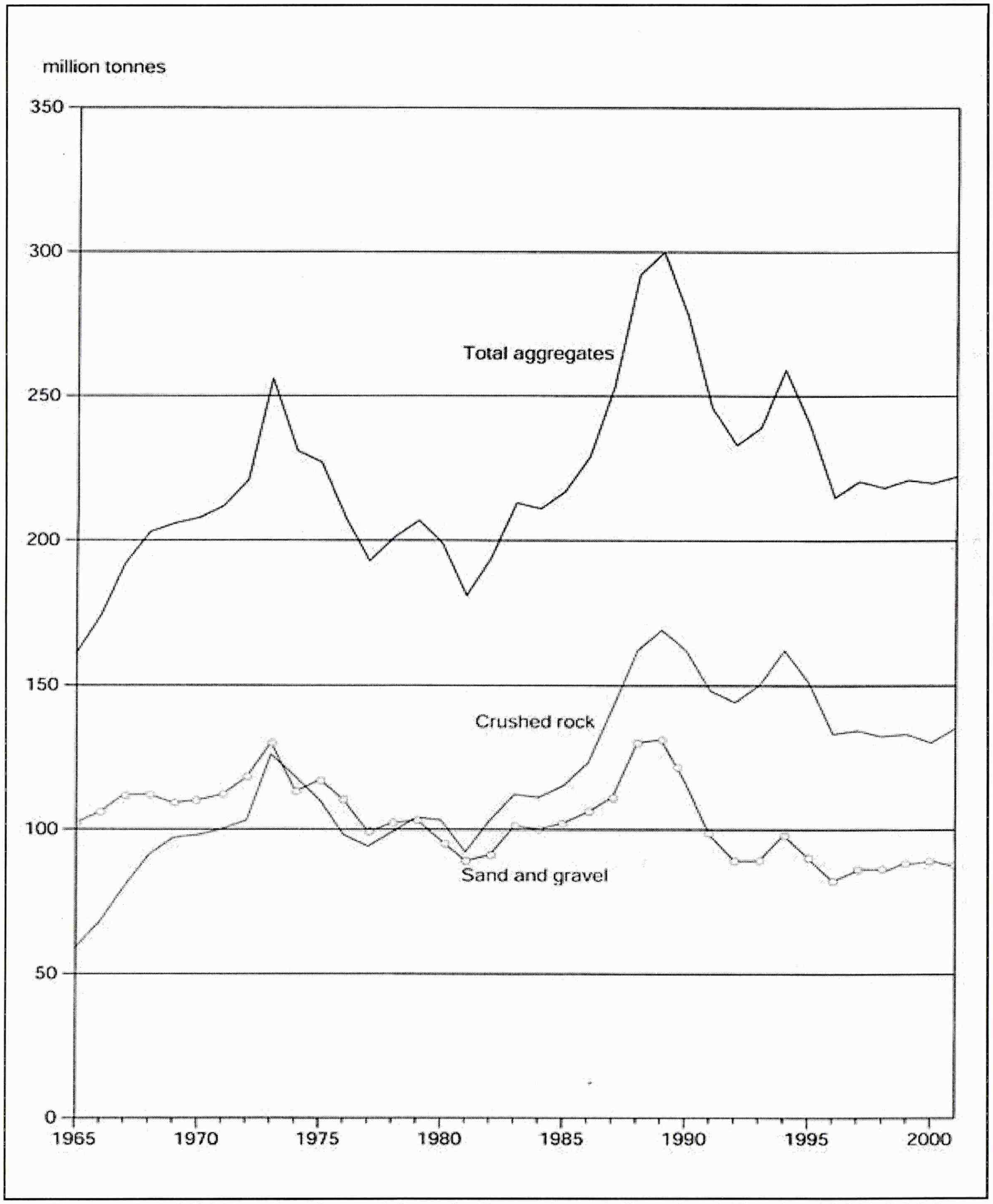

Figure 3.2 UK Production of Sand, Gravel and Crushed Rock, 1965-2002. (Source: Adapted from British Geological Survey, 2002b).

Million tonnes

Year	Crushed rock aggregate (c)				Sand and gravel (b)			Total crushed rock and sand and gravel
	Limestone (a)	Igneous rock	Sandstone	Total	Sand	Gravel	Total	
1955	11	13	3	27	...	...	61	88
1956	13	13	3	29	...	...	63	92
1957	13	13	4	30	...	...	60	90
1958	14	13	4	31	...	...	63	94
1959	17	14	3	34	33	35	68	102
1960	18	15	4	37	38	38	76	113
1961	20	16	4	40	42	43	85	125
1962	21	16	4	41	42	43	85	126
1963	23	17	4	44	44	45	89	133
1964	29	20	5	54	52	54	106	160
1965	34	20	5	59	50	52	102	161
1966	40	22	6	68	50	56	106	174
1967	48	25	7	80	52	60	112	192
1968	53	27	11	91	54	58	112	203
1969	55	28	14	97	52	57	109	206
1970	59	28	11	98	53	57	110	208
1971	62	29	9	100	53	59	112	212
1972	61	32	10	103	55	63	118	221
1973	74	38	14	126	62	68	130	256
1974	72	34	12	118	53	60	113	231
1975	67	32	10	110	54	63	117	227
1976	60	28	10	98	51	59	110	208
1977	59	26	9	94	46	53	99	193
1978	61	28	10	99	48	55	102	201
1979	65	29	10	104	49	54	103	207
1980	65	28	10	103	45	52	96	199
1981	57	25	10	92	41	48	89	182
1982	62	30	11	103	42	49	91	194
1983	70	31	11	112	46	55	101	213
1984	69	30	12	111	46	54	100	211
1985	72	32	11	115	47	55	102	217
1986	78	34	11	123	51	55	106	229
1987	89	39	14	142	53	58	111	253
1988	102	44	16	162	63	67	130	292
1989	106	46	16	169	64	67	131	300
1990	98	49	14	162	58	58	116	278
1991	90	46	13	148	49	49	98	246
1992	85	48	11	144	45	44	89	233
1993	89	49	12	150	45	44	89	239
1994	99	50	13	162	50	48	98	259
1995	87	49	15	151	47	43	90	240
1996	77	43	12	133	43	39	82	215
1997	80	42	12	134	45	42	86	220
1998	79	40	13	132	44	42	86	218
1999	76	45	11	133	45	43	88	221
2000	(d) 74	44	(d) 12	130	45	44	89	220
2001	(d) 78	45	(d) 11	134	45	43	88	222

Table 3.2 The Estimated Production of Aggregates in the UK 1955-2001. (Source: Adapted from British Geological Survey, 2002b).

In particular, the Government used Mineral Planning Guidance notes (MPGs) to achieve its objectives of encouraging competition, promoting economic growth, creating employment and achieving environmental protection (DoE, 1988). In 1989, the Government published MPG6 (DoE, 1989) *for the supply of aggregates in England and Wales*. It was reviewed in 1994 by the Department of Environment, Transport and Regions (DETR) as *guidance for the supply of aggregates in England.*

3.7.2.5 Minerals Planning Guidance Note 6 (MPG6)

The 1994 edition of Mineral Planning Guidance note 6 (MPG6, entitled '*Guidelines for Aggregates Provision in England*') attempts to provide advice to mineral planning authorities and the minerals industry on how to ensure an adequate and steady supply of aggregates to the construction industry, accounting for the balance of social, economic and environmental costs, through full consideration of all resources and the principles of sustainable development. This advice concerns all sources of aggregates, from land-won sand and gravel and crushed rock, to marine dredged aggregates and secondary aggregates such as recycled demolition materials (DETR, 2001).

MPG6 suggested that the total demand for aggregates in the UK can be expected to rise from 300 million tonnes a year in 1994 to about 400 million by 2011. MPG6 encouraged Mineral Planning Authorities to provide landbanks to overcome any increase in demand for aggregates. It also stated that an increasing level of supply of aggregates could be obtained from coastal superquarries over the period to 2006. But the report also noted that the cost and long lead time needed before such quarries could be brought on stream meant that this potential source would be unlikely to contribute greatly to demand in the years immediately following publication. MPG6 also supports the use of marine aggregates as a means of reducing the pressure on land of agricultural or environmental value. It states that marine aggregates will continue to contribute to maintaining supplies of aggregates for the construction industry.

The Office of the Deputy Prime Minister (ODPM) published revised Guidelines for Aggregates Production in England 2001-2016 on 10 June 2003. The guidelines for land-won aggregates provision in England contained in annex A of MPG6 (1994) have been revised for the period 2001-2016, and all other parts of MPG6 (1994) remain in force until revised (OPDM, 2003).

3.7.2.6 Landbanks

Mineral Planning Authorities are encouraged by MPG1 and MPG6 to use landbanks as sites with permission but not yet developed, to secure a steady supply of aggregates. This means that when demand for aggregates increases these sites can then quickly be brought into production. In the case of sand and gravel, the recommended time horizon for landbanks is seven years rather than ten years as stated in the earlier version MPG6 in 1989. There is no recommended period for crushed rock; however the 1994 version of MPG6 stated that crushed rock landbanks require a longer period than those in sand and gravel (Mellor, 1997).

The calculation of landbanks is provided in the 1994 edition of MPG6, which sets out two alternative methods:

- Where the Mineral Local Plan (MLP) or Unitary Development Plan (UDP) has been adopted and reflects local apportionment of the regional guidelines, the landbanks are calculated using the provisions included in the development plan expressed on an annual basis.
- Where the MLP/UDP does not reflect the guidelines, the landbanks are calculated using the average of the last three years production figures. This is divided into the reserves identified in the annual monitoring survey. No allowance is made for forecast increases in demand (DOE, 1994).

The Campaign for Protection Rural of England (CPRE) argues that MPG6 places pressure on planning authorities to provide land banks to meet the demand for aggregates for construction and, as a result, planning authorities have earmarked landbanks for quarrying which could affect a large area of countryside four times the size of Manchester (CPRE, 1999). It argues that the landbank system could create a large stock of a reserve which could lead to oversupply and falling prices of aggregates and which is regarded as running counter to the concept of sustainability. Instead they argue we can reduce demand for aggregates by promoting efficient use of materials, and avoiding the use of higher quality materials where lower ones will suffice. Use of recycled materials and secondary aggregates will reduce the demand for primary aggregates (Severn Estuary Partnership, 1997). Currently, recycled materials and secondary aggregates meet about 20-25% of total demand for aggregates; the government most improve policy in order to maximise their use in line with principles of sustainable development. Even so, recycled materials and secondary aggregates will only be able to meet part of total demand for aggregates because of their limited availability (BGS, 2003).

3.7.2.7 Superquarries

Coastal superquarries are large operations producing crushed rock or sand and gravel, which have access to low-cost transportation such as barges and railways and can serve large market areas. The MPG6 (1994) defined superquarries as" *those capable of producing 5 million tonnes or more of crushed aggregate per annum (mtpa) with reserves of at least 150 million tonnes, where the transport of the aggregate to the market is by sea or railways*". The concept of superquarries has been developed because of increasing environmental pressure against aggregate extraction in populated areas. Research in 1992 stated that it could be possible to develop about 15 to 20 costal superquarries in Western Europe. The majority of them could be in Norway with a few in Spain and about 5 in Scotland.

Supporters of super quarries argue that their development will secure a steady supply of aggregates, meeting the needs of South East England and elsewhere. Others argue that such developments would prove uneconomic or unsustainable. The British Aggregates and Construction Minerals Institute (BACMI) argued in the early 1990's that about 40 new superquarries would be required by 2011 to provide the projected 100 million tonnes of additional aggregates demand suggested by MPG6 (McLaughlin, 1993).

Kellett, 1995 pointed out that shifting demand from one site to another does not constitute a sustainable policy. Also, developing superquarries outside populated areas does not solve the whole problem created by aggregate extraction, thus the environmental effects, whether visual or on ecosystems or heritage, may be just as important as the effects on local populations around existing quarries.

At present only one superquarry exists in the UK, at Glensanda, Loch Linnhe (currently operating at about 5 mtpa but with consent to increase to 15 mtpa). This low number may be due to the decrease in the demand for aggregates and to the refusal of some applications, such as the Rodel superquarry proposal on the island of Harris (Barclay, 2004)

3.8. Development of the Regulatory Regime

Environmental legislation for minerals working in the UK is designed to improve the environmental performance of the mineral industry and to keep minerals extraction at an environmentally acceptable level. However, this has not always been the case. During 1946-48 there were a number of quarries in England and Wales operating on land under the Town Country Planning Act, 1932. These approvals were easily obtained for large areas with no impositions made about conditions of working or site rehabilitation and this caused many environmental impacts such as loss of soil, amenity and natural resources. New planning controls for mineral workings were needed to minimise this environmental impact (Blunden, 1975).

When the Town and Country Planning Act, 1947 came into force, it introduced general planning control over the development of land. However, many existing workings, which had begun operation before and/or during the Second World War, remained outside the new planning control. Those permissions represent some of the earliest remaining mineral permissions in the UK and were granted under Interim Development Order (IDOs) between 1943 and 1948, those permissions were granted under wartime emergency powers to meet wartime needs and post war construction; in many cases the planning authorities had no record of the permissions themselves and having little or no condition attached to them. (Brown, 1989). A number of permissions were granted in the early days of the 1947 Act by statutory order without detailed consideration of individual sites and in excess of operator's foreseeable requirements. These permissions contained only rudimentary provisions relating to working methods, the disposal of waste and restoration of the site after working (DoE, 1975b).

After the 1947 Act, many freeholders of land were able to apply for working permission to exploit minerals without any proof of the existence of workable reserves and with few if any, conditions for restoration of the site afterwards. During the 1950's, aggregates working permissions tended to contain only conditions about waste disposal. They ignored the possibility of mitigating against the impact of extractive operations during their active life and site rehabilitation. This resulted in many environmental impacts such as soil loss, water pollution, dust, noise and visual impacts (Blunden, 1975). This problem led some counties to mark an area for mineral extraction in their development plans. This was a forerunner of todays landbanks, and since the mid 1970's planning authorities have been more reluctant to give permission for mineral working outside the marked areas which have been designated for that purpose (Blunden, 1975).

The production of aggregates increased dramatically in the 1960's due to the increase in road building. This resulted in permission being given to a number of quarries to cover the need for these materials. In the late 1960's, the high demand for aggregates forced the government to encourage the extraction of marine sand and gravel to reduce the need for new quarries. After 1970, when the marine aggregates industry began to develop, the dredging of aggregates from the sea bed began to cause environmental problems, such as impacts on the marine ecosystem and coastal erosion, which is a significant issue on the east coast of England (Wright, 2004).

Since these early days, much has been learned about the control of mineral working (Maybe *et al.*, 1986). The Stevens Report (DoE, 1975b) highlighted the problems associated with planning permissions granted in the past, including the lack of adequate provision to meet current environmental protection standards or to provide for the satisfactory restoration of land following the cessation of extraction (Pollock *et al.*, 2002). Indeed, the modern reform of the mineral planning system started with the publication of the Stevens Committee Report which investigated the control of mineral working in great detail and made certain recommendations. This committee's recommendations formed the basis of the Town and Country Planning (Minerals) Act 1981, which was subsequently consolidated within the Town and Country Planning Act 1990.

The Town and Country Planning (Minerals) Act, 1981, was intended to deal with all inadequate minerals permissions, including the permissions granted before the 1947 Act, and permissions granted in the 1950s and 1960s. This Act introduced powers and duties for planning authorities in the UK to review periodically the conditions attached to mineral permission and to make it easier to update environmental conditions of older permissions. Also, concerning the reclamation of land after working, of particular importance are aftercare provisions, which attempt to ensure that land is not only reclaimed but also that this is achieved to a required standard (Brown, 1989).

Various orders were introduced in the 1981 Act to update existing permissions and bring them into line with modern standards. The orders include:

Revocation: Mineral Planning Authorities may choose to revoke a planning permission if considered expedient to do so, although this can only be used before working commences,

Modification: Mineral Planning Authorities allowed to alter, adopt, or add to permission by, for example, adapting or inserting new conditions changing the boundary of a defined site (this can be applied only before working commences),

Discontinuance: These orders refer to discontinuance of use of land and the orders take effect only if confirmed by the Secretary of State (in effect, these orders can stop minerals working at a site permanently),

Suspension: The aim of these orders was to tackle environmental problems arising from sites where operation had been temporarily suspended,

Prohibition: These aim to permanently stop mineral working at a site where no working has taken place for at least 2 years and it is unlikely that working will start again (the intention is to establish beyond doubt that it cannot be resumed without a fresh grant of planning permission and to secure restoration).

Due to many imperfections within the 1981 Act and regulations implementing it, reviewing and updating of conditions did not work well in practice, because all of the orders set out above could require local authorities to pay compensation for lost production and reserves. So the mmineral planning authorities were reluctant to risk incurring compensation liabilities that were difficult to assess in advance of using their order-making powers (Raynsford, 1997).

All relevant legislation since the 1981 Act has worked in line with the "Polluter Pays" principle, which is one of the core principles of sustainable development, stating that polluters must pay for the damage they cause. Its application should encourage the various parties concerned to take more precautions to reduce pollution (The European Commission, 2000). In line with the "Polluter Pays" principle, the minerals industry should bear the cost of updating permissions, and the onus should be on the industry to review operating and restoration requirements to make sure they meet modern standards and environmental principles. Hence, in recognition of the shortcomings of the 1981 Act, two further pieces of legislation were enacted to ensure this.

The first measure was the Planning and Compensation Act, 1991. The government undertook in the Environment White Paper (1991) to review the operation of the legislation and compensation arrangements relating to minerals permissions and how they could be improved. This Act introduced requirements for the registration and upgrading of permissions granted under Interim Development Order (IDOs) In September 1991, under the 1991 Act, the owners of these old permissions were asked to register these permissions with the local mineral planning authorities. Furthermore, they were required to apply for determination of the work conditions and restoration which needed to be complied with if the permission were to continue to be valid (DoE, 1991b).

The second measure was the Environment Act 1995, which introduced a new requirement under Section 96 for the Review of Old Planning Permissions (ROMPs) for minerals permissions granted in the period 1948 to 1982 where modern conditions do not apply. The initial review task for ROMPs granted between 1948 and 1982 was much more substantial than those before1948 IDOs, because the 1995 legislation covers permissions granted for nearly 35 years. Therefore, bringing the old permissions up to date will be done by reviewing of the active sites, which will take place in two consecutive phases, each phase of three years (Raynsford, 1997).

- **Phase 1** sites are those subject to planning permissions granted between 30 June 1948 and 1 April 1969, and all review sites which are wholly, or partly, located within National Parks, National Scenic Areas, Sites of Special Scientific Interest or Natural Heritage Areas
- **Phase 2** sites are those subject to planning permissions granted between 31 March 1969 and 22 February 1982 (DOE, 1995).

3.9. The Current Regulatory Regime

In the last decade, the regulatory regime to control the environmental impact of aggregates extraction and to improve the environmental performance of the UK aggregates industry has developed further, principally with MPG6, the increased role of the Environmental Agency, and the Aggregates Levy fund. Currently, applications for planning permission for minerals extraction are dealt with under the Town and Country Planning Act, 1991 as *"all substances in or* *under land a kind ordinarily worked for removal by underground or surface working, except that it does not include peat cut for purposes other than for sale"* (DOE, 1991a). The overall objectives of the minerals planning system are to reduce the demand for aggregates, to encourage the efficient use of materials including appropriate use of high quality materials, to minimise the production of waste from aggregates extraction, to maximise recycling of wastes where they occur, avoiding the use of good materials where lower grade material will suffice, and to promote sensitive working practices and minimise the environmental impacts on the environment (Aggregates Advisory Service, 1999). These policy aspirations are partly being met; although there is controversy over to what extent mineral extraction in the UK could currently be considered to be sustainable.

Another part of the policy framework for enhancing sustainability appeared in April 2002, when the government introduced an environmental tax called the Aggregates Levy on aggregate quarrying to incorporate the environmental costs imposed by aggregates extraction in to the price of virgin aggregates. It was expected that this would reduce the demand for quarried aggregates and encourage the use of alternative materials such as wastes from construction and demolition as secondary aggregates (Morgan, 2003). The Aggregates Levy was introduced by the Finance Act 2001. It includes all sand, gravel and crushed rock used for construction purposes, which are quarried from land or dredged from water in the UK (DEFRA, 2002). The Minister of Environment has stated that £58.6 million will be generated from the Aggregates Levy sustainability fund (DEFRA, 2002), which will be used to reduce the environmental impact of aggregate extraction, through initiatives in the following areas:

- *To reduce demand for primary aggregate,*
- *To reduce the effect of local aggregate extraction,*
- *To promote more environmental friendly extraction and transport of material,*
- *To fund local schemes run through Derbyshire, Leicestershire and Somerset county councils to improve all the areas affected by aggregate extraction* (DEFRA, 2002).

3.10. Chapter Summary

The extraction of aggregate involves a sequence of activities, starting from the search for mineral deposits through to end use of the site. The methods of extracting aggregates differ widely and depend on the location, type and size of mineral resources. Surface mining operations are more economic in situations where aggregate deposits occur close to the surface. If the resources lie at a depth underground mining operations are preferable because the cost of removing the overburden is expensive. All of the above activities have environmental impacts which will be discussed in more detail in the next chapter.

The second part of the chapter reviewed the development of UK legislation relating to the aggregates industry (particularly in England and Wales) in the past fifty years including demand for aggregates, demand forecasting, development of the regulatory regime and the current regulatory regime. This review shows the importance of the planning system and environmental legislation to people and the industry in the UK and how it has development to protect the land, water and communities in general. The next chapter (Chapter Four) will discuss the environmental impacts of the aggregates industry.

CHAPTER FOUR

Chapter Four
The Environmental Impacts of the Aggregates Industry-an International Overview

4.1 Introduction

This chapter describes the nature of the most significant environmental impacts arising from aggregates quarrying, which include blasting, dust, noise, visual, water and traffic impacts. Each issue is examined in turn, looking at both the nature of the impact and also the potential impacts they have on the land and the communities. The standards and guidelines designed to control the impacts also discussed.

Aggregates are non-renewable resources that can only be worked where they are found and aggregate extraction by its nature can have a major environmental impact on land and the communities (Morgan, 2003). From prospecting and exploration through post-closure, aggregate quarrying has the potential to cause environmental impacts. In addition to the obvious disturbance of the land surface, and the physical and visual changes to the landscape, aggregate extraction may affect, to varying degrees, groundwater, surface water, loss of habitat, loss of wildlife, soils, blasting effects, noise, dust, erosion, and sedimentation. Use of environmental laws and regulations in the aggregate extraction may reduce, limit, and control many of these impacts (CGER, 1999) but aggregate extraction will, to some extent, always alter landscapes and environmental resources.

Environmental laws and regulations intended to control, minimise and manage these alterations of the landscape and the environment in an acceptable way are generally in place and are updated as new technologies are developed to improve aggregate extraction, to reclaim mined lands, and to limit environmental impacts. Many of these impacts are discussed in this chapter. Nevertheless, an understanding of the potential for aggregate quarrying to cause environmental impacts is essential to assessing and suggesting improvements to the laws and regulations for aggregate quarrying in Libya.

4.2 Aims and Objectives

4.2.1 Aims

The main aim of this chapter is to review the environmental impacts of aggregate quarrying and the best practice to control them.

4.2.2 Objectives

1. Review the definition of the environmental impact and the impact identification.
2. Review the main environmental impacts associated with aggregates extractions and the best practice to control and minimise them with reference to the UK.

4.3 The Definition of Environmental Impact

"An environmental impact may be defined as a change in the environmental parameters, over a specified period of time and in a specified geographical

area resulting from a particular activity compared to the situation which would have existed had the activity not been performed" (Aswathanarayana, 2003).

Impacts on the environment can lead to changes in existing conditions; the impacts can be direct, indirect or cumulative. Direct impacts refer to all changes in environment systems that result from direct cause effect consequences of interactions between the environment and project activities, which occur at the same time and place as the project. Indirect impacts result from or are caused as a cost of interactions between the environment and direct impacts and often occur later in time or further away in distance than direct project impacts (COMNAP, 1999). For example, the effect of dust may not only be seen directly in the loss of local vegetation, but indirectly as a deterioration of the health and social structure of local people.

Cumulative impacts refer to the interaction in the environment that are caused by human activities in combination with other past, present and future human actions, which are repeated over time and dispersed over space (Hegmann *et al.,* 1999). (e.g. past, existing and proposed activities, including activities associated with the project under assessment). Flora and fauna close to the mining site for example can be affected by dust, noise etc... Cumulative impacts are one of the hardest impact categories to adequately identify in the environmental assessment process. It is imperative to consider both spatial and temporal aspects in order to identify cumulative impacts and also to identify other activities which have and might happen at the same site or within the same area (COMNAP, 1999).

4.3.1 Source-Pathway-Receptor

There are frameworks for environmental risk assessment, called the source-pathway-receptor model Figure 4.1 (DETR *et al.,* 2004).

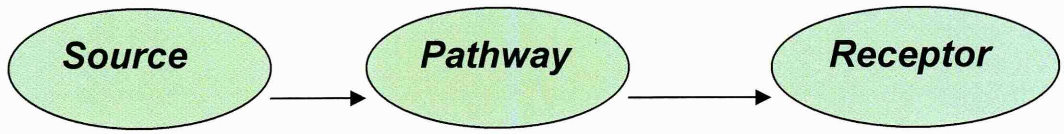

Figure 4.1. Basic Source-Pathway-Receptor Model

- **Sources** are the origins of environmental impacts, and have the potential to cause harm to human health, water resources or the wider environment.
- **Pathways** must be one or more routes or means by or through which a source of impact reach the receptor; an identified receptor can be exposed to, or affected by identified source.
- **Receptors** are those entities that are likely to be adversely affected by the identified hazards. These include human, flora, fauna, air, water, land and buildings (The Environment Agency, 2004).

Understanding and predicting the source-pathway-receptor relationship is an important step in the impact assessment process. The amount of the source is often referred to as the dose, while the amount of change this causes in the receptor is often called the response. For example, in the case of dust generated by aggregate quarrying, the dose is the amount of dust predicted to occur due to aggregate extraction at a given impact location, and the response is the predicted reaction or change caused by this new dust at the receptor, such as in flora, fauna and human health (Horne, 2004).

4.4 Impact Identification

There are a number of methods used to identify the major impacts from a proposed scheme. Munn (1979) has divided these methods into the generic classification, matrices, networks and checklists. Shopley and Fuggle's (1984) classification includes the following categories for impact identification:

- *Ad hoc approaches (e.g. project-, sector- or environment-specific guidelines);*
- *Checklists (i.e. the checking of potential impacts against a generic complete list);*
- *Matrices (e.g. the Leopold Matrix);*
- *Networks (i.e. the presentation of higher order impacts and linkages using directional diagrams);*
- *Overlay maps (e.g. the McHarg technique);*
- *Modelling procedures (i.e. computerized, mathematical, physical scale models or descriptive models).*

4.4.1 Assessing the Magnitude and Significance of Environmental Impact

Prediction of the environmental impact of a project is inevitably a critical stage. This involves estimating the magnitude of the potential impact, and comparing this to the measured baseline, in order to quantify the amount of change predicted. When such effects have been predicted, they must then be evaluated to assess their importance and relative significance with reference to the sensitivity of receptors.

4.4.1.1 Magnitude of Impact

Magnitude is a measure of the degree, extensiveness, or scale of impact. It also refers to the amount of change to be created by the impact (NRCA, 1997). The magnitude of impact has a number of different components, for example, the amount of physical change, the level of change in an environmental condition, its spatial extent, its duration and frequency, and its possibility of occurrence where the impact is not certain to occur (Marusich *et al.,* 2001). In short, magnitude is about measuring quantity as objectively as possible.

4.4.1.2 Significant of Impact

Significance is about assessing how important an impact is. Thompson (1990) states that significance of an impact is essentially an expression of the cost or value of an impact to society. Selected examples of definitions or interpretations from various authors are provided in Table 4.1. The significance and severity of impact reflects the relationship between two factors:

- The magnitude of impact, which is referred to as the amount and type of change or the actual change in the environment;
- The nature of the resource or receptor and its sensitivity to change and this is depending on the nature of the impact, timing scale, size and duration of the project; (Coventry *et al.,* 2004).

The impact magnitude is generally quantifiable, such as extent of land take or predicted change in noise levels. However it is more difficult to quantify the value and sensitivity of the resource or receptor and is usually derived from factors such as:

- The resource or receptor's designated status as stated in the land use planning system;
- The number of individual receptors such as residential receptors or area of natural habitat;
- An empirical assessment on the basis of its qualitative criteria such as rarity, extent and condition;
- The ability of the resource or receptor to absorb change (Coventry *et al.,* 2004).

The Impacts can not be significant if the resource values are low or not sensitive, also if there is small number of receptors subjected to low or short-term impacts.

Assessment of the significance of impacts arising from the proposed scheme is a key stage in the EIA process. It provides potentially key information in the decision making process. However, defining what is significant is not a simple task; not least, it involves assessing the amount of change to the environment perceived to be acceptable to the community. Determination of significant impacts relates to the degree of change in the environmental resource measured against existing standards, discussions, judgement and agreement. This should take into account the characteristics of the impact such as size of the affected population, magnitude, geographic extent, duration, frequency and reversibility of the impact (Canter, 1996). Also, the criteria and the applied methods used for ranking significance must be clearly presented.

Source	Definition or interpretation
Haug *et al.* (1984)	*Determining significance is ultimately a judgement call. The significance of a particular issue is determined by a threshold of concern, a priority of that concern, and a probability that a potential environmental impact may cross the threshold of concern.*
Duinker and Beanlands (1986)	*Significance of environmental impacts is centred on the effects of human activities and involves a value judgement by society of the significance or importance of these effects. Such judgements, often based on social and economic criteria, reflect the political reality of impact assessment in which significance is translated into public acceptability and desirability.*
Council on Environmental Quality (1987)	*The United States' National Environmental Policy Act requires significance to be determined within the framework of context and intensity. Context: The significance of an action must be analysed in several contexts such as society as a whole, the affected region, the affected interests, and the locality. Intensity: This refers to the severity of impact.*
Thompson (1988, 1990)	*The significance of an impact is an expression of the cost or value of an impact to society. The focus of EIA must be a judgement as to whether or not impacts are significant, based upon the value-judgements of society, or groups of people chosen to represent the wishes of society.*
Canter and Canty (1993)	*Significance can be considered on three levels: (1) significant and not mitigatible, (2) significant but mitigatible, and (3) insignificant. Significance is sometimes based on professional judgement, executive authority, the importance of the project/issue, sensitivity of the project/issue, and context, or by the controversy raised.*
US Environmental Protection Agency (1993)	*Determination of significance requires predicting change. These impact predictions are along with societal values, the major input to significance determination. Ideally, change should be compared against thresholds of concern, some of which may be legally mandated and others, which may be levels or states of valued components determined by the public, authorities or the EIA team.*
Sadler (1996)	*The evaluation of significance is subjective, contingent upon values, and dependent upon the environmental and community context. Scientific disciplinary and professional perspectives frame evaluations of significance. Scientists therefore evaluate significance differently from one another and from local communities.*
Sippe (1999)	*Environmental significance is an anthropocentric concept, which uses judgement and values to the same or greater extent than science-based criteria and standards. The degree of significance depends upon the nature (i.e. type, magnitude, intensity, etc.) of impacts and the importance communities place on them.*

Table 4.1: Selected Examples of the Definitions or Interpretations of the Concept of Significance (Rossouw, 2003).

The significance of impacts is assessed by numbers of key elements, which include:

- *Level of public concern;*
- *Scientific and professional judgement;*
- *Measure of disturbance to ecological systems;*
- *Impacts on social values and quality of life;*
- *Existence of environmental standards, that is, international, national, Provincial or local agreements; and*
- *Availability of mitigation practice and technology to ameliorate impacts* (Furman *et al.*, 1997).

4.5 Environmental Impacts of the Aggregate Extraction

The extraction of aggregate minerals and the transportation of these products to the market now represent one of the most important environmental impacts (positive and negative). Positive impacts include creation of employment, providing material for development, negative impact that cause noise, dust emissions, blasting vibrations, traffic, the water environment and visual impact. The negative environmental impacts will be discussed in this chapter because they are the main concern of this study.

4.5.1 Negative Environmental Impact

Technology improvement and scientific investigation methods have made it possible to reduce environmental impacts associated with extraction of minerals and manage impacts at acceptable levels that do not cause significant harm to the environment. Nevertheless, Aggregate resources (sand, gravel and crushed rock) can not be extracted from the surface without causing some environmental impacts such as:

4.5.1.1 Blasting

Blasting is putting an explosive in the ground to break rocks (Plate 4.1); an enormous amount of energy is released. The vast majority of this energy is used to do the work for which it was intended. The remaining energy goes out as vibration transmitted through or along the ground and pressure waves through the air which are known as "air overpressure".

Blasting is a hazardous component of surface mineral working. But the quarrying industry considers blasting a necessary factor for the success of their operations. However, Kuzu *et al* (2005) stated that the use of explosives to loosen the rock in the aggregate extraction are associated with undesirable and important side products which are ground vibration and air blast. Those two issues may cause an environmental problem if the operation is not well planned or close to residential areas and other structures.

Plate 4.1 Showing Blasting in an Aggregate Site (Source BGS, 2005b)

4.5.1.1.1 Impacts from Blasting

The five principal environmental impacts from blasting are:

1. Vibration: vibrations may be the most obvious and significant impact from blasting and have the potential to cause cosmetic or structural damage to properties. Cosmetic damage includes the formation of hairline cracks or the growth of existing cracks in the plaster or mortar joints. Structural damage is caused when the actual structural elements of the building are damaged. The actual damage is dependent on the level of vibration, the size and type of property and its general condition. The levels of vibration generated by aggregates workings are well below those required to cause structural damage to properties (DETR, 1998). Concern about vibration is usually expressed in terms of the fear of damage to owner-occupied property. Generally the property owner may believe that the cracks in the plaster have been caused by vibration even though they may have been

present for some time and caused by natural processes. There are a number of factors influencing the overall attitude of the individual towards the disturbance caused by ground vibrations, such as the degree of trust felt by an individual towards the site operator, the need for quarrying, understanding the need for blasting and the significance of vibration level felt.

2. Air overpressure: As with ground vibration, air overpressure radiates in all directions away from the blast site. The pressure waves consist of energy over a wide range of frequencies, some of which are audible and some inaudible. Although air overpressure has the potential to produce damage, the air overpressure generated by aggregates workings is unlikely to cause that damage (DETR, 1998). The effects of air overpressure are difficult to distinguish even for an expert without using appliances, but the pressure wave may arrive after the ground vibration by up to 2 seconds over a distance of 1 km. The attitude of individuals towards the impact from air overpressure is influenced by the same factors described for ground vibrations.
3. Flyrock: Fragments of rock propelled into the air by the explosion, which is the unpredictable throw of rock pieces beyond the designated danger zone. This is clearly potentially dangerous not only because people have been killed or injured, but property, equipment and materials can be damaged both inside and immediately outside the site (DOE, 1991c).
4. Dust: dust from blasting can arise from two sources, the drilling of the boreholes into which the explosive is placed and from the actual blast itself. Dust discussed more in Section 4.5.1.2

5. Noise: Noise is part of the pressure wave, and occurs at the same time as overpressure. noise is discussed more in Section 4.5.1.3

4.5.1.1.2 Best Practice to Control Blasting Impacts

There are a variety of measures that can be used to reduce or eliminate the problems associated with blasting. Department of Environment (1991c) stated the following:

1. Controlling the height of the working face and reduce the surface area subject to heave;
2. Regulating the times of blasting and provide advance notification of blasting to nearby residents;
3. Maintaining a minimum distance between the workings and any sensitive neighbouring dwellings;
4. Reducing the instantaneous charge weight to the minimum. The principal methods are introducing more delay detonators into the blasting sequence to separate explosions or considering alternative methods of detonation;
5. Avoid blasting in adverse weather conditions such as strong winds, foggy, hazy and significant temperature inversions especially when the wind is from the site towards sensitive receptor and there is low cloud;
6. Checking that all holes are loaded and avoid secondary blasting.

The measures described above are not exhaustive and only set out good blasting principles to control blasting impacts. These measures have been widely used in the UK aggregates industry.

4.5.1.2 Dust

Dust from aggregate working is often a significant nuisance and it is considered to be any solid matter that is generated as a result of mechanical activity from aggregate working such as extraction, blasting, loading, transport, crushing, etc, which is borne by the air. It's defined as small solid particles in the range 1-75µm (microns) in diameter (British standard 6069-2, 1994).

The wind borne emission of dust is dependent on wind speed, its direction and turbulence; the stronger the wind, the greater the amount of dust that will be collected and the further it will be transported. Higher turbulence leads to greater entertainment of the particles in airflow. A new site such as quarry where topsoil and overburden have recently been removed may lead to particularly high levels of dust. Experience has shown that dust emissions can also result from:

- Transport of material on un-surfaced routes and on nearby roads which are not adequately wetted and if vehicles are uncovered.
- Crushing and processing operations.
- Drilling and blasting operations.
- Restoration.

4.5.1.2.1 Impact from Dust

Dust emissions from quarrying and aggregate extraction activities can have a noticeable environmental impact and affect the quality of life of local communities and it may give rise to conflict between aggregates/quarry operators and local residents. In recent years the significance of dust impact associated with mining and quarrying activity has increased considerably. The public's perception of potential impacts of dust has increased as a function of the general increase in awareness of environmental issues (Coppin *et al.*, 1995).

Deposited dust is one of the main causes of complaint, and it's very dependent on the sensitivity of the receiving environment. As a result of this the dust can not be controlled or managed easily through the use of air quality guidelines, and fears are commonly expressed in relation to the alleged health effects of airborne dust.

The main potential effects of dust are:

1. Visual impact from dust emissions such as dust plumes, reduced visibility, air pollutions which leads to annoyance and loss of amenity such as coating and soiling of surfaces;
2. Chemical and physical contamination leading to mechanical or electrical faults (such as computers), soiling of finished products, spoilt paint or polished finishes, contamination of facilities like laboratory or medical facilities and abrasion of moving parts;
3. Covering of plants by dust and contamination of soils leading to changes in growth rates of vegetation, which may be reducing the value of agricultural products.
4. Contamination of water courses
5. Health impacts due to inhalation such as asthma (DOE, 1991c).

4.5.1.2.2 Best Practice to Control Dust Impacts

Controlling or minimising dust is the science of reducing harmful dust emissions from aggregate extraction by applying good planning and design such as:

1. Locate dust generating activities away from neighbours and dust sensitive receptors as far as possible.

2. Paving road surfaces within the site where a negative impact on a dust-sensitive receptor is likely;
3. Use water sprays to minimise dust pick up by wind in unpaved haul-roads, conveyors, stockpiles, material transfer points and any areas subject to wind erosion (Plates 4.2 and 4.3);
4. Get rid of dirt from vehicles before leaving the site, provide washing facilities to clean wheels and vehicles
5. Use sheets to cover fine dry loads or spray the loads prior to exiting the site, reduce speeds and limit movement of vehicles. also if necessary regular cleaning of public roads in the vicinity of the entrance;
6. The creation of buffer zones, windbreaks, Vegetated berms and Plantation of trees can restrict transport of dust; also screen the quarrying operation from surrounding landscaped (Plate 4.4).
7. Stop or avoid operation if the creation of dust emissions can not be controlled or reduced to an acceptable level (DOE, 1991c).

Plate 4.2 Water Sprays of Unpaved Haul-Roads to Minimise Dust Pick Up by Wind (Source Stevenson, 2004)

Plate 4.3 Water Sprays of Material Transfer Points to Minimise Dust Pick Up by Wind (Source NCGS, 2005)

Plate 4.4 Vegetated Berms and Plantation of Trees around the Site Can Restrict Transport of Dust (Photo Taken by the Author, 2005)

The Environment Agency presents a good summary of the main source of dust during aggregates extraction and the best way to reduced to an environmental acceptable level (Table4.2).

KEY METHODS OF REDUCING AND CONTROLLING DUST	
Soil handling and storage	Restrict the duration of the activity. Seal and seed storage mound surfaces as soon as is practicable. Protect surfaces from winds until disturbed areas are sealed and stable.
Overburden handling and storage	Protect exposed material from wind (by keeping material within voids or protecting them by topographical features). Spray exposed surfaces of mounds regularly to maintain surface moisture. Minimise handling.
Drilling and blasting	Use dust extraction equipment, such as filters, on exhaust air emissions from drill rigs. Remove the dusty material collected from the area of blast prior to detonation.
Loading/Unloading activities	Reduce drop heights wherever practicable. Protect activities from wind.
Minerals processing	Varies depending on types of equipment used but generally complete enclosure is best with use of air extraction and filter equipment as appropriate. Use water sprays.
Material storage	Dampen material. Protect from wind and store under cover. Screen material to remove dusty fractions prior to external storage.
Transport by conveyor within site	Protect by use of wind and roof boards. Shelter transfer points from wind. Use scrapers to clean belts, with collection of scrapings for disposal. Minimise drop heights and protect from wind. Use water sprays.
Transport by vehicle within and off-site	Restrict vehicle speed. Water unsurfaced roads. Wheel or body wash at an appropriate distance from site entrance. This should usually be inside the site entrance. Load and unload in areas protected from wind. Minimise drop heights. Sheet or cover loaded vehicles. Use water sprays/spray curtains to moisten material. Sweep paved roads Use paved roads where practicable

Table 4.2 Presenting Some Key Methods of Reducing and Controlling Dust Impact from Surface Mineral Working (Source the Environment Agency, 2003)

4.5.1.3 Noise

The definition of noise is unwanted sound. Sound is simply considered as any variation in air pressure that human ear can detect (The European Commission, 1996). Sound is the result of pressure changes in the air caused by vibration or turbulence. The amplitude of these pressure changes is stated in terms of sound level, and the rapidity with which these changes occur is the frequency of the sound. The duration of the sound and the way it is distributed in time are also important aspects:

1. Continuous sound level little or no variation in time;
2. Varying sounds which have differing maximum levels or frequency content over a period of time;
3. Intermittent sounds which are interspersed with quiet periods;
4. Impulsive sounds are characterised by relatively high sound levels and very short durations;
5. Tonal noise generated by certain frequency patterns (e.g. humming noise).

Mainly the duration and level of the noise determine the impacts of noise, but they are also influenced by the noise frequency. Long term, high level sounds are the most disturbing and damaging to human hearing and the most annoying. Low frequency sounds tend to be less dangerous to hearing and less disruptive than High frequency sounds. The way sounds are distributed in time is also important, in that discontinuous noise appear to be less damaging to human hearing than continuous noise because of the ear's ability to regenerate during the quiet periods. However, discontinuous and impulsive sounds tend to be more annoying because of their unpredictability (Suter, 1991).

Sources of noise from aggregate quarrying arise from activity both on and off-site. On site, noise may arise from equipment used for extraction and processing that involves the use of powered machinery for excavation and transport of materials within the site. Processing plant on site can often include the use of crushing and grading plant, prior to the material being transported off site by road or rail vehicles. On some sites, there will also be noise generated from the blasting of rock (DOE, 1993b).

4.5.1.3.1 Impact from Noise

The effects of noise are difficult to quantify as people's tolerance to noise levels and different types of noise varies considerably. Noise from aggregate quarrying can have a noticeable environmental impact and is a common cause of complaint. The potential effects of noise from an aggregates working are:

1. Prevent or disturb sleep, which started at noise level of about 30 dB (A) for steady state continuous noise at the sleeper's ear. Sleep disturbance may lead to frequent headaches and deterioration in mood.
2. Disturbance to the animals and birds which can be affected, mainly by sudden noises such as blasting noise.
3. Hearing loss is one of the most obvious effects of excessive exposure to noise. Hearing loss generally develops over a long period of time so the damage can be caused before the person is aware of what has happened.
4. Increased noise levels can interfere with speech and communication such as face to face or telephone conversations (DOE, 1991c).

All of the impacts from noise described above may not necessarily show themselves in areas around the quarry sites, but some of the impacts will be noticeable, either to a greater or lesser degree of prominence. Nevertheless, it is recognised that noise from aggregate extraction can have a significant impact on the environment and the quality of life of communities. It is therefore important that standards and guidelines are enforced to ensure that noise levels are kept to a minimum in a way that is environmentally acceptable as well as economic and efficient for the site operators.

4.5.1.3.2 Best Practice to Control Noise Impacts

Noise can be controlled at aggregate operations by several methods such as:

1. Construct baffle mounds or noise fence around the site boundary to provide acoustic and visual screening;
2. Use of the existing topography, buffer zone, berms, tree barriers or combinations of these methods together can help to contain the noise;
3. Select low noise emission equipment and ensure that sound-reduction equipment fitted to machinery is working properly and well maintained;
4. Keep haul routes within the site well maintained and avoid steep gradients. Also consider paving if sensitive receptors are likely to be affected;
5. Avoid unnecessary revving of engines and turn off equipment when it is not required;
6. Turn on plant and vehicles one after another rather than all together, and limit the use of particularly noisy plant or vehicles;
7. Minimise drop height of materials.

The methods stated above formulated the best practice to control noise impacts from surface mineral working (e.g. quarrying) and have been produced by the UK government (DOE, 1993a). These methods if well implemented will reduce the noise impact in the Libyan aggregates industry.

4.5.1.4 Visual Impacts

The term visual impact used to describe a systematic analysis of the possible impacts to the environment as a result of proposed development which can be positive (beneficial) or negative (adverse) in nature depending upon the circumstances (Nicholson, 1996). The visual effects of aggregate quarrying have not only been widely recognised, but nowadays are considered as one of the major environmental impacts. The exception to this is when good quarry restoration leads ultimately to the creation of new landscapes at least equivalent in visual terms to those that existed prior to extraction.

The visual impact from a development can result from several factors. Firstly there may be elements of the development which may contrast with the landscape in terms of form, height and colour, thereby creating an impact on the landscape. There are often perceived negative associations with industrial processes, which conjure up images of dereliction and disturbance. In addition, if the development is long term, it might be perceived as being more permanent and thus affecting a favourite viewpoint for some time. Theses factors can be affected by the topographic positioning of a development, the attitude of the observer, the characteristics of the viewpoint, the methods of working and the meteorological condition(rain, fog, haze, cloud cover) (Nicholson, 1996).

The environmental effect of quarrying on the landscape can be significant and unpleasant to the viewer. In general the significance of the change depends on the topography of the area and to the type of landscape, plants and vegetation. The potential sources of visual impact from quarrying activities are summarised in Table 4.3.

Quarry landforms • Soil and overburden storage mounds • Screen bunds • Stockpiles • Waste heaps- including scrap • Quarry faces- active and disused • Haul roads and associated embankments or ramps • Slurry ponds and settlement lagoons
Mobile plant • Mobile processing plant • Internal Quarry vehicles • Road Vehicles- especially at the main access
Built structures • Storage hoppers • Crushing and screening plant • Washing, attrition, dewatering plant • High-level walkways and conveyors • Concrete and bituminous plant • Exhaust stacks (The above elements tend to be more intrusive where raised above the skyline. Mitigation of visual impact is facilitated if these elements are concentrated in a limited area of the quarry)
Miscellaneous sources Long-range indicators of quarrying activity: • Air pollution (water vaper, dust, vehicle fumes) • Dust deposits (e.g. surrounding vegetation) • Mud on road • Lighting, especially during night time operation Other sources: • Long term alteration to the existing landform profile (e.g. removal of hills and woodlands) • Inappropriate perimeter planting

Table 4.3 The Potential Source of Visual Impact from Quarrying (Source, Nicholson, 1996).

4.5.1.4.1 Best Practice to Control Visual Impacts

In order to keep the visual impact of aggregate quarrying to a minimum the following may be considered:

1. Screening the quarry from view using the topography such as hills or by planting with mature trees, shrubs and plants. These actions could create or improve wildlife habitats and enhance the local ecology.
2. Use Landscaped mounds and overburden from the aggregate extraction to screen site and plant;

3. Locate and design the processing plant, lorry parks etc... to minimize the visibility at the outset;
4. controlling the dust;
5. Clean the quarry access; also screen the internal and external routs with mounds where necessary.
6. Use curved access route to conceal quarry from critical viewpoints (Nicholson, 1995).

The methods stated above by Nicholson (1995) as a best practice to control visual impacts from aggregate quarrying have been used in the UK aggregates industry. Using these methods in the Libyan aggregates industry could help to reduce the visual impacts.

4.5.1.5 Water

Aggregate quarrying by its very nature creates risks to surface water and groundwater. Indeed the removal of overlying vegetation and soil strata during the aggregates quarrying process means that the vulnerability of the groundwater to pollution is increased as the natural protection resistance is removed. Surface water may also be affected by the large quantities of silt, fine particulate solids, oil, fuels etc that are produced by the machinery and quarry equipment which can be carried into surface water by storm water effluent (The Environmental Agency, 2006). The quarrying industry has a very wide range of environmental impacts on the quality, levels and flow patterns of groundwater, surface water and the water environment in general.

According to MPG 11 (DOE, 1993a) there are potential effects of mineral workings on the surface water and ground water regimes. The most environmental impacts of aggregate quarrying on water environment are as follows:

A) The main potential effects of quarrying on the surface water regime are to:

1. Change the surface by quarrying which effect the flow regime;
2. Change the pattern of surface water flows, which reduce the water flow due to lack of recharge from groundwater;
3. Reduce the quantity, and physical and chemical quality of those flows.

B) The principal changes in the groundwater regime which may arise are:

1. The removal of the top layers (overburden, mineral and soil) in the quarrying area and replace it by imported materials for another place during site restoration may change:
   - The quality of the infiltration water recharging the aquifer,
   - The rates and timing of recharge of the aquifer and surface water flows,
2. Quarrying may dewater or divert surface water courses from one place and discharge it in another which may:
   - change the supply of water to abstractions and spring-fed surface water courses,
   - lead to settlement of the ground surface, buildings, etc,
   - change the quality of the water before discharging it,
3. Discharges from the equipment and machinery in the quarry such as oil, fuel spoilage may cause physical and chemical contamination.

4.5.1.5.1 Best Practice to Control Water Impacts

These effects inevitably can be more wide-reaching than most other environmental impacts, because of the way water moves, but if appropriate mitigation is in place with careful assessment, planning, monitoring and control most of these adverse effects can be anticipated and prevented, or at least minimised. The Department of Environment (1991c) states some suggestions to minimise quarrying impact on the water environment:

1. Avoid oil, fuel and chemical spoilage;
2. Monitor or check ground water levels, quantity and quality of recharge flows and neighbouring abstractions during operations;
3. Consider not dewatering, if it's unavoidable, try to use observation wells or progressively dewater in cells and reduce the inflow of water by sealing;
4. Provide bunding to keep surface water out of workings;
5. Minimise obstruction of flood regime by using retention ponds and traps of overburden or waste;
6. Try to limit erosion by vegetation or roughening the surfaces of overburden, soil or waste mounds also restoring working areas and lining water courses helps to reduce erosion;
7. Avoid extracting materials below the water table especially if the site is close to the sea which will cause sea water intrusion to ground water.

The above suggestions which have been stated by the Department of Environment to minimise quarrying impact on the water environment in the UK aggregates industry, could help to reduce the water impacts in the Libyan aggregates industry.

4.5.1.6 Traffic (Aggregate Transportation)

Aggregate transport basically refers to a means of conveying aggregates from site to processing or to the point of use. Most aggregate quarries transport their material by road, which causes various environmental impacts such as increased congestion, together with visual intrusion, air pollution, dust, noise and vibration, through to reduced access and safety.

Traffic impact is one of the most intractable problems associated with quarrying of aggregate and the potential off-site effects of traffic are:

1. The number and size of vehicles on the road which may cause congestion, accidents or difficulties for pedestrians;
2. Damage roads or their verges which can give rise to damage to other vehicles or cause accidents;
3. Spills or drops of loaded material onto roads and possibly spreading dust;
4. Creation of visual disturbance, air pollution, dust, noise and vibration in areas nearby the transportation roads;
5. Generate late evening/early morning parking nuisances near quarry sites (DOE, 1991c).

4.5.1.6.1 Best Practice to Control Traffic Impacts

Using alternative transport methods may decrease these impacts, otherwise, sensible planning of routes and times and using high standard of vehicle condition and driver behaviour can all help to minimize the impacts.

The Department of Environment (1991c) states some suggestions to minimise traffic impact to the environment:

1. Provision of sign-posting in the quarry site entrance including information and instructions to show the driver which way vehicles can turn;
2. Covering or sheeting of Lorries before leaving the site to minimise materials drop and dust emission along the transport route;
3. Providing washing facilities adequate for wheels and vehicle;
4. Seek alternative transportation methods to longer distance road haulage, e.g. rail, waterways;
5. Avoid sensitive areas and using large vehicles in narrow winding roads which are not designed for large vehicles and heavy traffic;
6. Require that drivers use agreed routes, also making sure that they use wheel/vehicle washing facilities and sheet their vehicles where appropriate;
7. Enforce agreed vehicle arrival/departure times.

The above suggestions have been stated by the Department of Environment to minimise quarrying impact on traffic in the UK aggregates industry. Using these suggestions in the Libyan aggregates industry could help to reduce the traffic impacts.

4.6 Chapter Summary

This chapter has reviewed the theory of environmental impact and how it can be assessed according to its magnitude and significance. It has also described the environmental impacts associated with each stage of extraction of aggregates and how they can be kept at an acceptable level.

Impacts on the environment can lead to changes in existing conditions; the impacts can be direct, indirect or cumulative. The first step to assess these impacts is to understand and predict the source-pathway-receptor relationship and the second step is to assess the magnitude and the significance of these impacts to in order to design an appropriate mitigation strategy before the project commences.

The aggregates extraction industry is an important industrial sector in every country in the world and millions of tonnes of aggregates (crushed rock and sand and gravel) are extracted for use for construction purposes. Aggregate extraction activities are carried out in various stages starting from prospecting and exploration through post-closure. Each stage has the potential to cause environmental impacts to varying degrees, such as impact to groundwater, surface water, loss of habitat, loss of wildlife, soils, blasting effects, noise, dust, erosion, and sedimentation.

Technology improvement and scientific investigation methods have made it possible to reduce environmental impacts associated with extraction of minerals and manage impacts at acceptable levels that do not cause significant harm to the environment.

The UK environmental systems and guidelines have been used to suggest the best practice to control and minimise the environmental impacts associated with aggregate extraction. On the other hand the UK experience in this field is going to be used in the development of the recommendations for the Libyan Aggregates Industry and government organisations which will help towards reducing the actual and perceived environmental impacts of aggregate extraction. The next chapter (Chapter Five) will define the detailed research methodology that was chosen to carry out this research.

CHAPTER FIVE

Chapter Five
Research Methodology

5.1 Introduction

This chapter presents an overview of the research methodology adopted to accomplish the study's objectives. According to Adam and Haley (2000) a research methodology is the overall approach taken to investigate the issue of concern, and within that, the individual research methods and tools used to meet the given research objective. Zickmund (2000) considers methodology as the procedures for collecting and analysing the required information. In order to select an appropriate research methodology and decide on the data collection techniques, a clear and unambiguous statement of the research aim and objectives is therefore necessary. This information appears in Chapter One (Section 1.3).

This chapter is concerned with the strategies, methods and techniques adopted to gather the primary data for the study. It begins with a discussion of the research question, research process, research philosophy, research approaches, an overview of research strategies, and then justifies the choice of the case study approach as the strategy adopted, and the particular government organisations chosen. Finally, the study's particular data collection techniques of semi-structured interview, questionnaire and documentation search are examined.

5.2 The Research Questions

The research questions are the questions which identify the nature of the research problem that needs to be focused on by the researcher. According to Yin (1994) the important step that needs to be taken into a research study is defining research questions and sufficient time should be given for this task. Designing a good research question is considered to be the most difficult task of a research project (Stake, 1995) Hence, research questions define the methodological foundation of a research project. As Blaxter et al., (1996) elaborate, when one gets the research question right, it then should suggest not just the field for study, but also the methods for carrying out the research and the kind of analysis required. Research questions are like objectives, rather than aims whereby they should contain within themselves the means for assessing their achievement.

According to Clifford and Marcus (1986) and Cuba and Lincoln (1994), research methods should be determined by the research question and methodological position of the researcher. Drawing from the critical review of the literature and the research statement, it emerged that there are weaknesses within the current planning system in Libya. The consequence is the ineffective implementation of the environmental laws and regulations. Therefore, the main research question guiding this research is:

Why has the Libyan Aggregates Industry created environmental impacts and why has the planning system been ineffective and failed to control them?

Principally, the research is about identifying and understanding the Libyan aggregates industry and its environmental impacts. Further to this, the research will eventually make recommendations that will help towards reducing the actual and perceived environmental impacts of aggregate extraction now and in the future and will find answers to the following questions:

- What are the main environmental polices that have been adopted during the last two decades?
- Who are the parties responsible for implementing these polices?
- What are the main factors that make the planning regime ineffective?
- What can be done to improve the current planning regime?

5.3 The Research Process: Theoretical Background

Figure 5.1 indicates that the research process consists of a number of stages, which include the research philosophy, research approaches, research strategies, data collection methods as well as time horizons. Having begun to understand the nature of research it is necessary to consider a research paradigm, and in this respect the two main philosophies are referred to as 'positivist' and 'phenomenological', or quantitative and qualitative (Collis and Hussey 2003). However, these can also be referred to as 'positivism' and 'interpretivism', and they comprise views about the way in which knowledge is developed and judged as being acceptable (Saunders *et al.,* 2003).

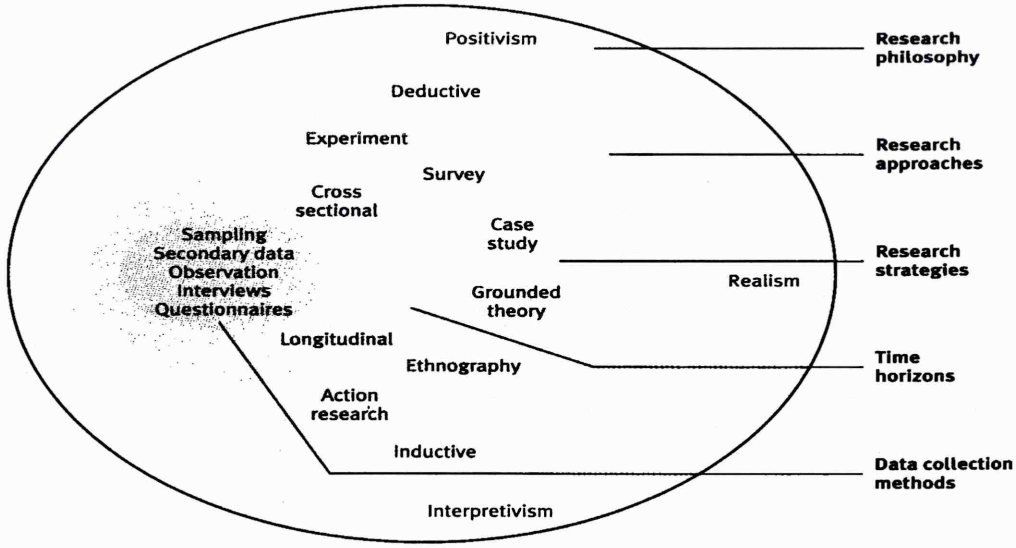

Figure 5.1: The research process (Saunders *et al.,* 2003)

5.3.1 Research Philosophy

The choice of a method for this particular study was difficult, but as Collis and Hussey (2003) note, the choice of a research method will help to determine the types of tools, which can be used to collect the research data. Collis and Hussey (2003) explain that the term 'paradigm' refers to a system of scientific practice that is based on a group of people accepting certain philosophies and assumptions about the world and the nature of knowledge as well as the validity of particular types of research strategy. These paradigms offer a framework comprised of a set of theories, methods or ways of defining data. The two paradigms already noted should be considered, according to Collis and Hussey (2003) as representing the extremes of a spectrum of possible examples.

This debate has centred on the relative value of two fundamentally different and competing schools of thought or inquiry paradigms (Amaratunga et al., 2002):

- Logical positivism uses quantitative and experimental methods to test hypothetical-deductive generalisations; and

- Phenomenological (Interpretive) Science inquiry uses qualitative and naturalistic approaches to understand inductively and holistically experience in context-specific settings. This approach tries to understand and explain a phenomenon, rather than search for external causes or fundamental laws (Easterby-Smith et al., 1991).

These differences and some of the key features of both approaches are therefore summarised in Table 5.1:

	Positivist paradigm	**Phenomenological paradigm**
Basic beliefs:	The world is external and objective. Observer is independent. Science is value-free.	The world is socially constructed as subjective. Observer is part of what observed. Science is driven by human interests
Researcher should:	Focus on facts ***Look for causality*** and fundamental laws Reduce phenomenon to simplest elements Formulate hypotheses and then test them.	Focus on meanings. Try to understand what is happening. Look at the totality of each situation. Develop ideas through induction from data.
Preferred methods include:	Operationalising concepts so that they can be measured. Taking large samples.	Using multiple methods to establish different views of phenomena. Small samples investigated in depth or over time.

Table 5.1: Key features of positivist and phenomenological paradigms (Easterby-Smith, 1991)

Given the nature of this research along with a deep understanding of the strengths and weaknesses of each of the above paradigms that are summarised in Table 5.2 below, the phenomenological approach is chosen as the main philosophy to conduct the empirical investigations (Saunders *et al.,* 2000). This choice is determined by the fact that this study will aim to investigate the environmental effects of quarrying in Libya and the regulatory regime to control them with reference to the institutional framework and social and cultural influences in Libya.

	Strengths	**Weaknesses**
Positivist or (quantitative paradigm)	- They can provide wide coverage of the range of situations. - They can be fast and economical. - Where statistics are aggregated from large samples, they may be of considerable relevance to policy decisions.	- The methods used tend to be rather inflexible and artificial. - They are not very effective in understanding processes or the significance that people attach to actions. - They are not very helpful in generating theories. Because they focus on what is, or what has been recently, they make it hard for policy makers to infer what changes and actions should take place in the future.
Phenomenological or (qualitative paradigm)	- Data gathering methods seen more as natural than artificial - Ability to look at change processes over time. - Ability to understand people's meaning. - Ability to adjust to new issues and ideas as they emerge. - Contribute to theory generation.	- Analysis and Interpretation of data may be more difficult - Harder to control the pace, progress and end-points of research process. - Policy makers may give low credibility to results from qualitative approach.

Table 5.2: Strengths and Weaknesses of Research Paradigms (Amaratunga *et al.,* 2002)

5.3.2 Research Approaches

Different types of research are based on differing conceptions of the nature of science, and a common theme in the literature is for authors to classify types of research according to two main paradigms (Brannick and Roche, 1997) Hussey and Hussey, 1997) have classified the different types of research according to:

- The purpose of the research;
- The process of the research;

- The logic of the research; and
- The outcome of the research.

Whereas, the purpose means the reason for the conduct of the research, and the process means the way in which data will be collected and analysed, and the logic refers to whether the researcher is moving from the general to the specific or vice versa, and lastly, the outcome refers to whether the researcher is trying to solve a particular problem or make a general contribution to knowledge (Hussey and Hussey, 1997). Table 5.3 shows the classification of the main types of research according to specific criteria of evaluation.

Basic of classification	Type of research
Purpose of the research	Exploratory, descriptive, analytical (explanatory) or predictive research
Process of the research	Quantitative or qualitative research
Logic of the research	Deductive or inductive research
Outcome of the research	Applied or basic (pure) research

Table 5.3: Classification of the main types of research (Hussey and Hussey, 1997)

Furthermore, it is worth showing how the quantitative and qualitative approaches benefit the data collection purpose:

1- Quantitative approach

- Separates the phenomenon from the surrounding environment and makes a free standing assessment;
- Maintains distance and objectivity from the research subject; and

- Observes without inter-relating to what is observed (positivistic ideal).

2- Qualitative approach

The qualitative approach tends to take a completely opposite view. It is grounded on the assumption that there is a single objective reality and the nature of the reality under investigation is related to the interaction of the research with it.

This approach yields rich and complex data where the findings focus on the qualities of the research subject, rather than their numeric measurement. Further, it is observed that qualitative research is a source of well-grounded, rich descriptions and explanations of processes in identifiable local contexts (Amaratunga *et al.,* 2002). However, quantitative research is where the researcher emphasises careful control and measurement by assigning numbers to measurements (Hussey and Hussey, 1997). Easterby-Smith *et al.,* (1991) pointed out that using both methods enables the researcher to study hard facts and human perceptions by quantitative methods, whereas qualitative methods can be used for interpretation. Also Ghauri *et al.,* (1995), state that the main difference between qualitative and quantitative research is procedure rather than quality. In qualitative research, findings are not established by statistical methods or any other procedures of quantification. However, in some social studies, data may be quantified, but the analysis itself is qualitative.

5.3.2.1 Selection of the Research Approach

In deciding whether to use a quantitative or a qualitative approach, it is necessary to explore these alternatives in more depth. Qualitative research is a source of well-grounded rich description and explanations of process in identifiable local contexts (Amaratunga *et al.,* 2002). It focuses on words rather than numbers. Furthermore, qualitative research can be attuned to change, sequences of events and behaviours and the transformation of culture (Dayman and Holloway, 2002). Miles and Huberman (1994) note that it is essentially an investigation process in which the research is inductive in nature. Marshall and Rossman (1999) argued that:

"qualitative methodologists have described three major purposes for research: to explore, explain, or describe the phenomenon of interest".

As a result, the qualitative approach can allow powerful insights, and produce findings that lead to conclusions, and therefore, the researcher has chosen this approach. Table 5.4 (based on Hussey and Hussey, 1997) captures the key features of the two main paradigms. The purposes of exploratory and explanatory studies are indicated in Table 5.5.

Qualitative	Quantitative
- Uses small samples	- Uses large samples
- Concerned with generating theories	- Concerned with hypothesis testing
- Data is rich and subjective	- Data is highly specified precise
- The location is natural	- The location is artificial
- Reliability is low	- Reliability is high
- Validity is high	- Validity is low
-Generalises from one setting to another	- Generalises from sample to population

Table 5.4 Features of the Two Main Paradigms (Hussey and Hussey, 1997)

It is also possible to triangulate data by combining both approaches.

Exploratory Study	Explanatory Study
- Investigate phenomena.	- Explain the patterns related to the phenomenon in questions.
- Identify or discover important categories of meaning.	- Identify plausible relationships shaping the phenomenon.
- Generate further research.	–

Table 5.5: Purpose of exploratory and explanatory studies

Given the characteristics identified in Table 5.4, this research study can be categorised as an exploratory and explanatory and the research approach adopted for this study is discussed in Section 5.4

5.3.2.2 Triangulation

The use of both quantitative and qualitative methods in the same study is known as *triangulation,* which Denzin (1989) defines as:

"The combination of methodologies in the study of the same phenomenon".

Triangulation refers to the use of different data collection methods within one study in order to ensure that the data from different collection methods agree. For example, semi-structured group interviews may be a valuable way of triangulating data collected by other means such as a questionnaire (Saunders *et al*., 2000). Easterby-Smith, *et al*., (2002) identify four types of triangulation: theoretical triangulation, where a theory is taken from one discipline and used to explain a situation in another discipline; data triangulation, where data is collected at different times or from different sources in the study of a phenomenon; triangulation by investigators, where different researchers independently collect data on the same phenomenon and compare the results; and methodological triangulation, where both quantitative and qualitative methods of data collection are used. Triangulation techniques were used in this study between the data obtained from the literature and the fieldwork observation, the questionnaire surveys and the interviews in order to make sure that the final results are of a real value for this research. Triangulation methods are mainly employed during research to collect data in order to test the validity of the information collected for a case study.

5.3.3 Research Strategies: An Overview

A research strategy is a way of conducting research, embodying a particular style and employing different research methods. When undertaking empirical research, there are two approaches to data collection, these being qualitative and quantitative as already discussed and each has its strengths and weaknesses as discussed in Section 5.3.2. It can be said that the qualitative method allows authors to study selected issues in depth and detail, but can rarely handle large samples; in contrast, the quantitative method can cope with large samples, but some of the depth permitted by qualitative techniques is beyond its reach. Another useful distinction is that between deductive and inductive research. The former starts with a theoretical proposition, which is then tested by a strategy designed for that purpose, whereas the latter develops theory from observed facts (Saunders *et al.,* 2003).

Research strategies available for conducting social science investigations, the category into which the present research falls, may themselves be categorised in many different ways. According to Saunders *et al.,* (2003), however, the main research strategies are

"Experiment, survey, case study, grounded theory and action research"

These can be briefly characterised as follows:

- Experiment (definition of a theoretical hypothesis and selection of samples);
- Survey (associated with the deductive approach);
- Case study (the strategy chosen for this research);
- Grounded theory (data collection starts without the formation of an initial theoretical framework – inductive);
- Action research (concerned with the management of change and involving close collaboration between practitioners and researchers).

According to Yin (1994), a research strategy should be chosen as a function of the research situation, because each research study differs, however, slightly, and therefore there will be advantages and disadvantages to be gained by certain collection and analysis techniques. However, although each strategy has its own defining characteristics, there are overlapping areas, which bring complexity to the process of strategy selection. Saunders *et al.,* (2003) observe the benefits of adopting a research strategy to include:

- Allowing yourself sufficient time;
- Using existing contacts and developing new ones;
- Providing a clear account of purpose and type of access required;
- Overcoming organisational concerns about granting access;
- Using suitable language;
- Facilitating ease of reply when requesting access;

- Developing access on an incremental basis; and
- Establishing researcher credibility with intended participants.

Yin (1994) points out that the case study is particularly suitable when the researcher questions are 'why' and 'how' rather than 'who', 'what', 'where', 'how many', and 'how much', which are more easily dealt with by the use of survey techniques. In addition, Yin (1994) notes that the case study as a research strategy is preferred when researchers are examining contemporary events. With this particular approach, both qualitative and quantitative measures can be used as warranted.

From the above discussion the case study strategy has been chosen in this study and section 5.4.3 describes this strategy in some details.

5.3.4 Research Design

The research design is the programme that guides the investigator in the process of collecting, analysing and interpreting observation (Nachmias and Nachmias, 1996). Research design however embraces a number of research strategies. The decision of the choice between different research strategies (experiment, survey and case study) is based on the specific features of the different strategies. The aim of the research design is to satisfy the research aim and objectives. Yin (2003) and Denzin (2000), define the research design as to "*guide the investigator in the process of collecting, analysing and interpreting observation. It is a logical model of proof that allows the research to draw inferences concerning causal relations among the variables under* *investigation*". The research design should demonstrate how the research question will be answered and how the researcher intends to cope with it. On the other hand, research design provides the plan and structure as to how explanation could be obtained. Yin (2003) states five different types of research strategies. They are experiment, survey, archival, history and case study. The relevant situations for different research design are summarized in Table 5.6 below.

Strategy	Form of research question	Requires control over behavioural events?	Focuses on contemporary events?
Experiment	How, why	Yes	Yes
Survey	Who, what, where, how many, how much	No	Yes
Archival Analysis	Who, what, where, how many, how much	No	Yes/no
History	How, why	No	No
Case study	How, why	No	Yes

Table 5.6: Relevant Situations for Different Research strategies (Source: Yin, (2003)

5.4 The Research Approach Adopted for this Study

The research approach adopted in this study has relied mainly on qualitative methods. According to Amaratunga *et al.,* (2002), a qualitative approach allows for a holistic focus on a wide range of interconnected activities, experiences, beliefs and values of people in terms of the context, rather than directing attention to one or two variables, and Ghauri *et al.,* (1995) point out that:

"Qualitative methods are therefore more suitable when the objectives of the study demand in-depth insight into a phenomenon."

The nature of reality is defined by the interaction of the researcher with the phenomenon being studied, and consequently, in this type of research, researchers can be free to apply their own perceptions and assumptions (Strauss and Corbin, 1990). In contrast, a quantitative approach has the weakness that it is not possible to ascertain deeper underlying meanings and a full explanation of the phenomenon, even when the data obtained are significantly reliable and valid.

One major feature of qualitative data is that they focus on naturally occurring, ordinary events in natural settings, so it gives a real life view. Their richness and holism, with strong potential for revealing complexity are other features of qualitative data. Furthermore, the fact that such qualitative data are typically collected over a sustained period makes the approach powerful for studying any process. Qualitative data with their emphasis on people's "lived experience" are fundamentally well suited for locating the meanings people place on the events' processes and structures of their perceptions and assumptions (Amaratunga *et al.*, 2002).

Gummeson (1999) cites that while quantitative research is concerned with issues such as how much, how often, how many, qualitative research on the other hand is concerned with identifying certain phenomena based on an in-depth exhaustive investigation and analysis.

Following the discussion above, the researcher has chosen the qualitative approach as a main source of information because the aim is to reach a full understanding of the environmental impact of the Libyan aggregate industry being studied and quantitative data alone will not produce that. Qualitative analyses driving from direct questions or open-ended questions can establish the reasons why the government organisations behave the way they do. This facilitates a better understanding, and provides further details in relation to the practical behaviour of organisations. Moreover, it has a direct impact on supporting the final results and conclusions of this study.

The selected research philosophy allowed this researcher to obtain in depth and rich data by using 'why' and 'how' questioning in the interviews with government organisations' employees, at different levels to thoroughly investigate any barriers to environmental protection development at the aggregates industry in particular and the Libyan context in general. The respondents were knowledgeable about the aggregates industry environmental impacts and environmental policies and were able, under detailed questioning, to provide clear and relevant information. In addition by using a questionnaire, the researcher was able to explore the attitudes of a broad sample of quarry staff about environmental impacts in general and environmental protection in particular. The use of both research approaches – qualitative and quantitative - allowed the researcher to investigate any variations in the opinions of government organisations' employees and quarry staff toward environmental protection and development.

5.4.1 Selection of the Case Study Strategy

Yin (1994) appears to operate from realist ontology when he defends the case study method against attacks, especially in relation to the three forms of validity: construct validity, internal validity, and external validity. A key suggestion for dealing with construct validity is to use multiple sources of evidence; for internal validity Yin (2003) stresses the importance of building cases over time in order to eliminate alternative explanation; and for external validity he points out that case studies rely on analytical rather than statistical generalisations.

Sekaran (2003) stated that case studies involve in-depth, contextual analysis of similar situations in other organisations, where the nature and definition of the problem happen to be the same as experienced in the current situation. Further, Remenyi *et al.,* (1998) define the case study as: "a detailed investigation of the context and processes that affect a phenomenon within organisations". Yin (2003) defines the case study as "an empirical investigation into contemporary phenomenon operating in a real-life context". He also states that the case study is the preferred strategy when "how" or "why" questions are being posed. This allows the researcher to determine not only what happened but also, why it happened. Therefore, the case study is excellent as a recorder of decisions, reasons, motivations and structural relationships (Leavy, 1994).

Yin (2003) points out that the case study as a research strategy comprises an all-encompassing method, covering the logic of design, data collection techniques, and specific approaches to data analysis. In this sense, the case study is neither a data collection tactic nor merely a design feature alone but should be seen as a comprehensive research strategy. Case study research, according to Yin (2003) can include both single-and multiple-case studies, which may be based on any mix of qualitative and quantitative evidence, and from the findings broader generalisations can be made to cover a wider population.

Case studies require multiple data collection methods, whose results hopefully converge, in order to establish construct validity. These data collection techniques are identified by Yin (1984) as including direct or indirect observation, structured or unstructured interviews, and the examination of documentation and other records, but in this research, a variety of techniques were available, consisting of documentation and archival records, interviews, questionnaires, direct observation, and participant observation. Bell (1999) states that the case study method is particularly appropriate for individual researchers, because it gives the opportunity for one aspect of a problem to be studied in-depth within a limited time scale. The great strength of the method is that it allows the researcher to concentrate on a specific instance or situation to identify, or attempt to identify, the various interactive processes at work. Eisenhardt, (1989) suggested that case studies are required to study quality management issues, which may be contextually defined, or situation-dependent. All these characteristics of the case study method justify its selection by the researcher for this study.

At this point it should be noted that having chosen the case study method as an overall research strategy, the researcher has chosen to use semi-structured interviews for the government organisations' employees. These respondents know about the environmental impact of the aggregates industry and the environmental policies and were able under detailed questioning to give the researcher a clear picture of what goes on there, In addition the author adopted a questionnaire for a sample of quarries staff, as well as considering organisations documentation and fieldwork observation as data collection techniques. This particular strategy allows for the gathering of data by more than one method, which helps in triangulating the information obtained, and permits the author to concentrate upon depth and breadth.

5.4.2 Data Collection Methods

When it comes to data collection, a researcher must be willing to use all available sources of evidence including but not limited to interviews, documentation and observation (Beyh, 2004). Yin (1994) emphasises that there is no single source of evidence that has a complete advantage over all the others. Interviewing, however is found to be the most widely used data collection technique in a qualitative approach thanks to its high level of flexibility and its capability of producing data of a great depth. Therefore, based on this discussion, the author-investigator has used the interview technique to collect the necessary data for this research but without neglecting other available techniques such as questionnaire surveys and workshops that also seemed suitable for the advantage of this research.

Therefore it was concluded that, after reviewing a number of the above mentioned data collection techniques, in this study data were collected mainly through the use of semi-structured interviews from participants within the government organisations (Environmental General Authorities, Industrial Research Centre and local authorities) and supported by questionnaire to quarry staff. A fieldwork plan was prepared to guide the researcher in the data collection process. The plan described the research setting and the main participants to be asked in the study. It also highlighted the issues to be discussed with the participants. The questionnaire distribution, interview process, number of interviewees, the timing of interviews, etc. these are explained in more detail in Chapter Seven. Displaying the questionnaire and the interview data in tables and other forms is a helpful tool to reduce, categorise, understand and interpret the data. Therefore, after the collection process, the data were analyzed using Excel and SPSS Software. The data collected by the open-ended questions were grouped and reduced into different categories. Categorising this data helped the researcher to develop an understanding of the respondents' opinion about environmental protection and their organisations' role in the planning systems. After collecting and analysing the data, a summary of the findings was provided.

5.4.2.1 Validity and Reliability of Data Collection Methods

Qualitative research is evaluated by reference to its validity and reliability, and in respect of validity both internal and external validity must be assured. Amaratunga *et al.,* (2002) point out that internal validity:

"...refers to what or not what are identified as the causes actually produce what has been interpreted as the 'effect' or 'response' and checks whether the right cause-and-effect relationships have been established".

While external validity:

"...refers to the extent to which any research findings can be generalised beyond the immediate research sample or setting in which the research took place".

Validity mainly focuses on the extent to which research data and methods for obtaining the data are deemed accurate and honest. Hussey and Hussey (1997) point out that validity is:

"…the extent to which the research findings accurately represent what is really happening in the situation".

Sapsford (1999) agrees that the most important factor to consider in the design of questionnaires or interviews to be used as a research measurement tool is validity:

"…At its minimum, this means asking, whether the question asks (or the observation records), what it was meant to record. Does it do so with a fair degree of accuracy; every effort is made to minimise error (which can be conceptualised as 'noise around a signal', concealing real differences or relationships in a cloud of imprecision or, worse, bias). Where the nature of what is supposed to be being measured is not itself straightforward but depends on theoretical interpretation, more extended arguments about validity may be necessary. This involves validating the theoretical arguments as well as the measurements which depend on them."

Sapsford (1999) continues and points out that people differ, and therefore what is an appropriate and effective stimulus for one is inappropriate or ineffective for another. To take the very simplest example, English is not everyone's first language, so when the interviewer meets a speaker of some other language there are three choices, says Sapsford; the first is to reject the respondent, confining the sample to speakers of English; the second is to translate perhaps altering the schedule of questions; and the third is to collect data that are likely to be useless because the questions were not properly or fully understood. In general, Oppenheim (1992) points out that researcher should not be seeking a mechanical identity of procedures, but should be aiming to create a set of valid questions, which are understood in the same way by everyone. According to

Saunders *et al.,* (2003), the design of a questionnaire will affect the response rate and the reliability and validity of the data collected, which can all be maximised by paying close attention to the design of individual questions, providing a clear layout of the questionnaire form, giving a lucid explanation of the purpose of the questionnaire, carefully planning and executing the administration of the questionnaire, and pilot testing it to remove any ambiguities. In this study, the researcher conducted a pilot study described later in this chapter, to increase both validity and reliability of questions.

Reliability is concerned with the consistency of the research and is one aspect of the credibility of the research findings. It is affected by the way the sample is selected, their responses are collected, analysed and interpreted, and as Yin (1994) outlined, it is the extent to which a test or procedure produces similar results under constant conditions on all occasions. Discussing internal validity and reliability, Amaratunga *et al.,* (2002) highlighted that reliability deals with the data collection process to ensure consistency of results, but internal validity focuses more on the way such results support conclusions. The goal of reliability is to minimise the errors and biases in research. Also, relating to the case study designs adopted by the researcher in this research, four tests were recommended by Yin (2003) to judge the quality of research design. They are:

- *Construct validity, establishing correct operational measures for the concepts being studied.*
- *Internal validity, establishing a causal relationship, whereby certain conditions are shown to lead to other conditions.*
- *External validity, establishing the domain to which a study's findings can be genaralised.*

- *Reliability, demonstrating that the operations of a study such as the data collection procedures can be repeated, with the same results.*

Table 5.7 shows four widely used tests and the recommended tactics in different stages of case study research.

Tests	Case study tactics	Phase of research in Which tactic occurs
Construct validity	-use of multiple sources of evidence. -establish chain of evidence. -have key informants review draft case study report.	-data collection. -data collection. - composition.
Internal validity	-do pattern-matching. -do explanation-building. -address rival explanations. -use logic models.	-data analysis. -data analysis. -data analysis. -data analysis.
External validity	-use theory in single case studies. -use replication logic in multiple case studies.	-research design. -research design.
Reliability	-use case study protocol. -develop case study database.	-data collection. -data collection.

Table 5.7: Case study tactics for four design tests (Source: Yin, 2003)

5.4.2.2 Data Collection Instruments

Yin (2003) states that the researcher can use six sources of evidence: interviews, documents, direct observation, archival records, participant observation and physical artefacts, and each has strengths and weaknesses as shown in Table 5.8. The multiple sources of evidence give multiple measures of the same phenomenon (Yin, 2003).

Also Yin (2003) points out that:

"*The various sources are highly complementary and a good case study will therefore want to use as many sources as possible".*

In this research, the field study was conducted in Libya, using a qualitative approach, and obtaining data which represents respondents' interviews, employees' questionnaire responses, fieldwork observation and analysis of documents. This is because using these sources of data collection methods strengthens the information needed. Through the use of triangulation, any case study bias was reduced.

Source of evidence	Strengths	Weaknesses
Documentation	-Stable - can be reviewed repeatedly. -Unobtrusive - not created as a result of the case study. -Exact -ontains exact names, references and details of an event. Broad coverage -ong span of time, many events and many settings.	-Retrievability -can be below. -biased selectivity, if collection is incomplete. -Reporting bias - reflects (unknown) bias of author. -Access - may be deliberately blocked.
Archival records	-(same as above for documentation). -Precise and quantitative.	-(same as above for documentation). -accessibility - due to privacy reasons.
Interviews	-Targeted – focuses directly on case study topic. Insightful – provides perceived causal inferences.	-bias due to poorly constructed questions. -response bias. -Inaccuracies - interviewee gives what interviewer wants to hear.
Direct observation	-Reality - covers events in real time. -Contextual - covers context of event.	-time consuming. -Selectivity - unless broad coverage. -Reflexivity - event may proceed differently because it is being observed. -Cost - hours needed by human observers.
Participant-observation	-(same as above for direct observation). -insightful into interpersonal behaviour and motives.	-(same as above for direct observation). -bias due to investigator's manipulation of events.
Physical artefacts	-insightful into cultural features. -insightful into technical operations.	-Selectivity. -Availability.

Table 5.8: Six sources of evidence: Strengths and Weaknesses (Source: Yin, 2003)

5.4.2.3 Questionnaire Design and Development

Williams (2003) states that the design of the questionnaire itself should not be approached independently, but seen as integral to the successful design of the survey, and this includes anticipating how the researcher might analyse the responses obtained. Good questionnaire design, therefore, is about maximising the validity and reliability of the survey.

Bryman (2001) states questionnaires that are completed by respondents themselves are one of the main instruments for gathering data in a survey and points out that in many ways the self-completion questionnaire and the structured interview are very similar methods of social research. The obvious difference between them however, says Bryman, is that with the self-completion questionnaire there is no interviewer to ask the questions. Therefore, the respondents must read and answer each question themselves, and this means that the self-completion questionnaire has to be especially easy to follow and its questions have to be particularly easy to answer.

According to Walters (1996), it is important to make sure that the questionnaire is going to provide all the detail needed, so all the questions needed should be asked precisely and unequivocally. In most questionnaires, the majority of items are multiple- or forced-choice questions, and this occurs for two main reasons, says Walters. The first is to make the questionnaire as easy as possible to complete and ideally, the researcher should construct if so that it can be completed in a very short time, probably no more than an hour, with a minimum of intellectual and physical effort. This does not mean however, that the researcher does not want the respondents to think about their answers, and it is quite possible, according to Walters (1996), to design multiple-choice questions that encourage respondents to think before they tick. In a multiple-choice questionnaire, the researcher wants respondents' intellectual efforts to go into selecting the most appropriate answer rather than into framing an elegant response.

The second, slightly less favourable, reason for using multiple-choice questions is that, in using such an instrument, the researcher is in part trying to obtain quantifiable information. If a researcher does not use multiple-choice questions, s/he may find him/herself faced with 200 different responses, which would then have to be crudely reduced into broad categories for analytical purposes. By using multiple-choice questions, the researcher is simply predetermining the categories so that, respondents have to choose between them.

In this study, the researcher distributed the questionnaire to a sample of quarry staff, because the total population was too large for a complete survey, and the majority of staff is illiterate, with no knowledge about environmental impact, environmental polices, plans and strategies. The purpose of gaining the quarries staff data was to enhance and support the information obtained from the interviews with the government organisations employees' population.

5.4.2.4 Primary Data Collection Techniques

According to Ghauri *et al* (1995) there are a number of primary data collection techniques that can be used. These techniques appear in Figure 5.2, where it can be seen that interviews may be structured, semi-structured or unstructured and can be carried out by post, face to face, by telephone or e-mail. For this study, the author has chosen to use the interview as a primary data collection technique, and because the number of the employees interviewed within the case study was manageable, face-to-face semi-structured interviews were conducted.

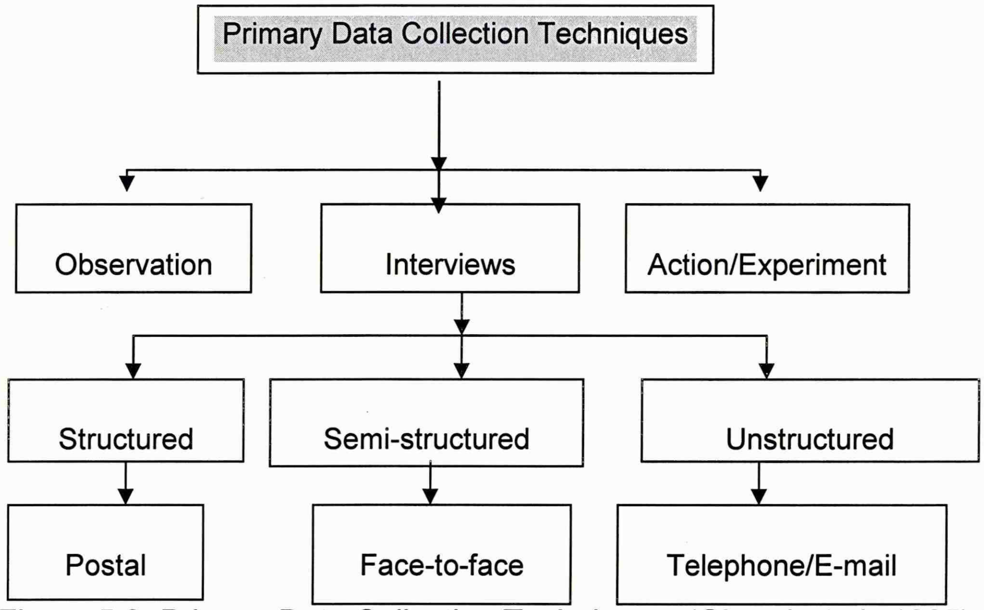

Figure 5.2; Primary Data Collection Techniques. (Ghauri *et al.*, 1995).

This strategy had several benefits. Firstly, it provided the opportunity for the author to obtain the attitudes from the entire management population, thus making it possible to generalise from these responses. Secondly, the use of an interview provided a 100% response rate to the questions asked, and even if a respondent was reluctant to answer, it was possible for the researcher to pose the question in a different way in order to extract as much information as possible. Thirdly, the opportunity to probe particular issues as they arose was available, and therefore any problems regarding environmental protection could be identified. Finally, this type of interview allowed for the collection of rich, extensive data, since the respondents were responsible for issuing the permissions, implement the environmental policies, strategies and associated environmental issues.

5.4.2.5 Interviews

Talking about interviews as a research instrument in general, Amarantunga *et al.,* (2002), quoted King (1994) who stated that the interview is the most widely used in a qualitative approach because it is a highly flexible method and can be used almost anywhere and is capable of producing data of great depth. Additionally Oppenheim (1992) believes that interviews come into their own when the researcher needs to ask numerous open-ended questions. Of course in this instance the interviewer has to record verbatim the answers given by the respondents. Such open-ended questions are important in allowing the respondents to say what they think. Interviews allow them to do so, with greater richness and spontaneity. It is also suggested by Oppenheim (1992) that another advantage of using interviews is that, because of the face-to-face contact there is a chance of improved response rates. Oppenheim states that a further advantage in the use of interviewers is that they can give a prepared explanation of the purpose of the study more convincingly than a covering letter. In addition they can help those people who may have reading difficulties, and offer standardised explanations to certain questions. This involvement may prevent many misunderstandings, and allow the interviewer to maintain control over the order in which the questions are answered. Generally according to Oppenheim (1992) it can be said that:

"The longer, the more difficult and the more open-ended the question schedule is, the more we should prefer to use interviewers".

Saunders *et al.*, (2000) describe the different types of interview as follows:

- Structured interviews (use questionnaires based on a predetermined and standardised or identical set of questions);
- Semi-structured interviews (the author will have a list of themes and questions to be covered although these may very from interview to interview);

- Unstructured interviews (these are used to explore in depth a general area of interest to the author).

As Jankowicz (2000) noted the semi-structured interview is a powerful data collection technique when used within the context of a case study research method and face-to-face semi-structured interviews are widely recognised as an ideal tool with which to generate rich qualitative data regarding the phenomenon under investigation. But also it was understood that unstructured interviews run the risk of generating too much information and bearing in mind the need for the author to operate in a second language, were believed to be inappropriate.

It is also accepted that interviews are not easy to conduct and in this respect Saunders *et al.,* (2000) emphasise that the interviewer must be able to demonstrate competence in interviewing, especially in relation to the following:

- Opening the interview;
- Using appropriate language;
- Questioning;
- Listening;
- Testing and summarising understanding;
- Behavioural cues;
- Recording data.

From the above discussion semi-structured interviews were chosen as a main source of data collection in this research. The researcher conducted the interviews within a month and interviewed one to two respondents a day. The semi-structured interview questions were generated from the fieldwork observation (Chapter Six) and other issues arising in the literature review regarding environmental protection in general and the environmental impact of aggregates extraction in particular. The different types of questions represent different approaches to making implicit knowledge explicit (Flick, 2002). The interview questions were designed to achieve the aim and objectives of this research.

5.4.2.6 Documentation

The researcher collected secondary data from a review of the literature relating to environmental protection and the environmental impact of aggregates extraction, which has been conducted through Library and Internet research in which textbooks, journals articles, bulletins, news letters, professional body publications, and seminars reports pertaining to the subject matter have been used. Yin (1994) suggests that a variety of documents might be available to the case study investigator, such as:

- Letters, memoranda, and other communiqués.
- Agendas, announcements and minutes of meetings, and other reports of events.
- Administrative documents – proposals, progress reports, and other internal documents.
- Formal studies or evaluations of the same "site" under study.
- Newspaper clippings and other articles appearing in the mass media.

Specifically, the documents reviewed by the author from the Libyan aggregate Industry and the government organisations and used in the case study are:

1- The Libyan aggregate Industry

- Monthly reports.
- Annual plans reports.
- Annual production reports.

* Other materials, such as photos.

2- The Libyan government organisations

* Reports about the aggregates industry.
* Papers and journals published by the Libyan Universities.
* The Libyan environmental Laws and regulations.
* The guidance notes for the aggregates industry.
* Papers containing complaints about the aggregates industry.

The researcher asked the Libyan aggregate Industry and the government organisations for their permission to review related documents, and all agreed, informing the researcher that he was entitled to search for any document himself, and to ask any questions that might arise. Such co-operation and ease of access occurred because he had been using his friendship with some of the employees inside those organisations.

5.4.3 Pre-testing

This researcher conducted two pilot studies to identify any problems in relation to the semi-structured interview and the questionnaire.

5.4.3.1 Pre-test One

In the first pilot study the researcher approached four Arab and Libyan nationals living in the UK, one of them has got a PhD in English Arabic translation and asked them to comment on the Arabic translations of the government organisations employees' interview schedule, and also on the translation of the quarries staff questionnaire. Each of these assessors confirmed that the translations were acceptable and declared that in their opinion any respondent would have a complete understanding of what was required of them by the survey. This pre-test was intended not only to check the translation of questions into Arabic, but also the validity and reliability of the questioning, because as Casely and Lury (1989) pointed out, translations into local languages can cause great difficulty when the languages concerned do not have the vocabulary to handle shades of meanings that occur in the original language. The test was also intended to test the phraseology used in the questionnaire. These assessors were not asked to comment in any way on the content of the questions used, as their sophistication, intelligence level and obvious understanding of terms used could not be compared with that of the actual respondents to the questionnaire, since they (the assessors) were PhD students and therefore had a much higher educational standard than the target respondents at aggregate industry.

5.4.3.2 Pre-test Two

In the second pilot study the researcher sent copies of the questionnaire to five companies from the aggregate industry and copies of the interview to the three government organisations in Libya and asked the surveyors there to provide feedback on any questions, which they found difficult to understand or any phrases, which they felt would cause confusion. Five quarry managers, one supervisor and seven general employees were piloted and were asked to give an indication of the length of time it took them to complete the questionnaire. Additionally friends at the government organisations interviewed one senior manager and two inspectors using the proposed interview schedule to gain feedback regarding its suitability. The typical response time to the questionnaire was 20-30 minutes and the interview took 45 minutes to one hour to complete.

By carrying out these pilot studies the researcher attempted to introduce a certain level of consistency into the questions and phrases used which would increase validity and reliability of these data collection tools. As a result of the second pilot certain additions and amendments were made to the questionnaire and the interview schedules before they were finalised, translated into Arabic and distributed for completion, The final interview and questionnaire questions can be seen in appendices.

5.4.4 Data Analysis

Mixed data collection methods were used in this research to interpret the data. In qualitative research, the typical analytical procedures are categorised into six phases (Marshall & Rossman, 1999); i.e. organising the data; generating categories, themes and patterns; coding the data; testing the emergent understanding; searching for alternative explanations; and writing the report. This approach was adopted in this research. The analysis of the data collected will cover these six phases with the use of a computer aided software programme like SPSS.

To interpret the data, the researcher followed the steps recommended by Amaratunga *et al.,* (2002):

- *Look for patterns of agreement - cross data sources, by mediating variables, with literature, with experience.*
- *Look for contradictions - across data sources, by mediating variables, with literature, with experience.*
- *Try to resolve contradictions - through alternative plausible explanations for a finding, by re-examining the data.*
- *Identify the most important findings - rank and organise them.*
- *Present the findings simply through charts and tables.*

Amaratunga *et al.,* (2002) highlighted different ways to analyse research evidence involving examining, tabulating or otherwise recombining the evidence to address the initial propositions of a study. In this respect, Yin (2003) noted that *"analysing case study research evidence is especially difficult because the strategies and techniques have not been well defined".* Some writers have suggested techniques to solve this problem. The researcher adopted the procedures in analysing the data collected mentioned by Yin (2003), and Collis and Hussey (2003). Yin (2003) quoted Miles and Huberman (1994) who proposed the following technique for analysing qualitative data (and this was adopted by the researcher in this study):

- *Putting information into different arrays.*
- *Making a matrix of categories and placing the evidence within each category.*
- *Creating data displays-flowcharts and other graphics – for examining the data.*
- *Tabulating the frequency of different events.*
- *Examining the complexity of such tabulations and their relationships by calculating second-order numbers such as means and variance.*
- *Putting information in chronological order or using some other temporal scheme.*

Like Yin (2003), Collis and Hussey (2003) quoted Miles and Huberman (1994) who offered a general analytical procedure for dealing with qualitative data as below:

- *Convert any rough field notes the researchers have made into some form of written record. The researcher should distinguish his interpretations and speculation from factual field notes.*
- *Ensure that any material collected from interviews and documents or any other instrument is properly referenced. The reference should indicate who was involved, the data and time, the context, the circumstances leading to the data collection and the possible implication of the research.*
- *Start coding the data as early as possible. This will involve allocating a specific code to each variable, concept or theme that the research wishes to identify. The code allows the researcher to store the data, retrieve it and reorganise it in a variety of ways.*
- *When data is coded, the researcher can start grouping the codes into smaller categories according to patterns or themes, which emerge. The researcher can use the conceptual framework to group them.*
- *At various stages write summaries of findings at that point.*
- *Use summaries to construct generalisations with which can confront existing theories or use to construct a new theory.*
- *Continue the process until you are satisfied that the generalisations arising from the data are sufficiently robust to stand the analysis of existing theories or the construction of the new theory.*

Analysis of the interviews was made qualitatively, especially since the aim of this was to permit some free and wide-ranging discussion. For ease of analysis, the researcher searched for themes that emerged in the responses, and clustered the responses along these lines after grouping, classifying and tabulating the responses. Chapter seven presents' data collected from the government organisations employees. The questions asked of the respondents were multiple-choice in order to assist in their analysis, but where employees volunteered additional comments, those were analysed using a thematic approach.

To establish the reliability, validity and rigour in the case study data, a quantitative element will be incorporated through the questionnaire survey, as a triangulation method. The triangulation method is employed to reduce/eliminate the disadvantages of each individual approach, whether qualitative or quantitative, whilst gaining the advantages of the other techniques and the combination and multi-dimensional view of the subject gained through synergy (Fellows and Liu, 1997). Data from the questionnaire survey of quarry staff was coded and input on to a computer. The SPSS /win computer package has been used to help the researcher to analyse and present the data. The main steps in the quantitative and qualitative data analysis (questionnaires and the interview questions) were:

a) Frequency distribution: this is considered to be a simple means of exploring data by showing the frequency and the percentage of the variable categories. The findings were illustrated in tables.
b) Measure of association: cross-tabulations were used to show the association between the variables.

5.5 Research Programme

The overall design for this research is illustrated in Figure. 5.3, which shows that in Stage 1, a review of existing literature in the area of environmental impacts of aggregate extraction in the West as well as in the Arab countries, was conducted in order to investigate the main environmental impacts associated with the aggregate extraction and the best way to control them. In Stage 2, a combination of research methodologies was used and as a result of the information gathered in Stage 1, tools for data collection were constructed. In Stage 3, pilot studies were carried out during March and April 2005 to help in the development of the questions to be asked of the respondents. In Stage 4, the actual case study was conducted during March and April 2006 at the aggregate Industry and the government organisations in Libya, and as a result a number of environmental impacts and barriers to the implementation of the environmental laws and regulations and various consequential effects, were identified. In Stage 5, the data analysis for the questionnaire and interview was undertaken using spreadsheet packages (Excel) and the Statistical Package for the Social Sciences (SPSS), while the analysis of some of the interviews questions was undertaken qualitatively. In the next stage of the research, Stage 6, the author was able to investigate the main environmental impact of aggregate extraction in Libya, and that lead to a discussion of the data collected and compare it to main literature' research in Stage 7. In the final stage, Stage 8 of the research, an analysis of all the relevant data was carried out in order to reach some conclusions and recommendations which will be presented in Chapter Nine.

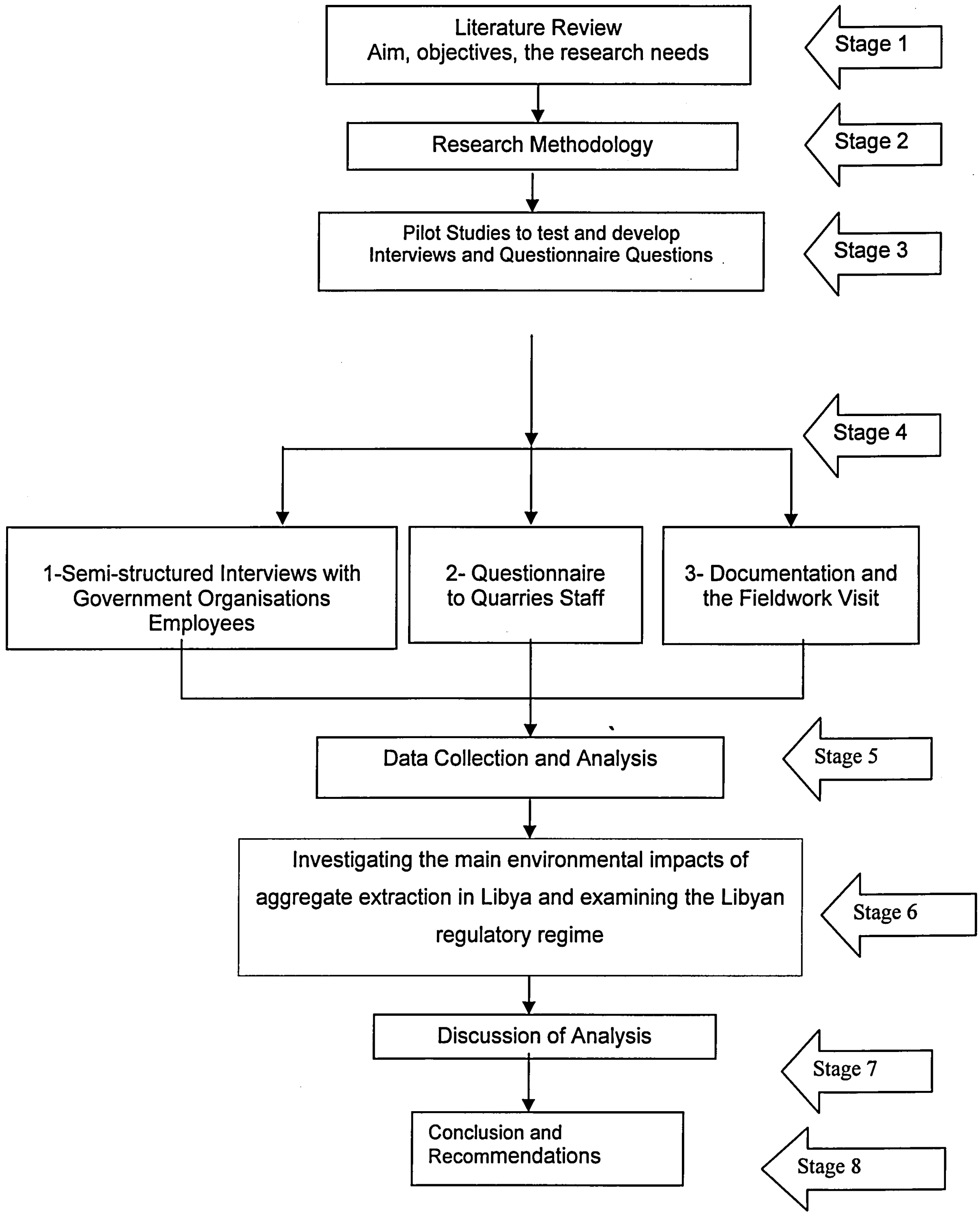

Figure 5.3: The Research Programme

5.6 Chapter Summary

This chapter has presented a discussion of the methodology used in the study, and a justification of the research philosophy, approach, design and data collection methods chosen. Among different qualitative methods available, the case study approach is best suited to the research question and to the objectives of the research. The particular techniques used in building up the case studies have been described, these being semi-structured interviews, a questionnaire and documentation, which together allowed for the collection of primary data to enhance the validity and reliability of the responses. The aim of the research will be achieved by investigating the environmental effects of the aggregates industry in Libya and how social and cultural influences affect the Libyan regulatory regime in control environmental impacts and also making recommendations that will help to controlling these impacts now and in the future based on the analysis of the literature review, case studies and the questionnaire survey. The next chapter of this thesis presents and analyses the data collected during the fieldwork visits (pilot study).

CHAPTER SIX

Chapter Six
Fieldwork Observations

6.1. Introduction

A number of information sources were used in this study. These include documentary evidence from the case studies, of which a report on the environmental impact of the aggregate extraction was part. Additionally, the author's knowledge of the industry and observations made during the field visit made in March and April 2005 are presented in this chapter.

6.2. The Pre-Research Investigation

The importance of conducting a pre-research investigation is to explore the feasibility of studying the research issue(s) and to help in deciding the research methodology and method(s). Fieldwork research provides first-hand insight into the issue under investigation from the participants' perspective (Ghauri et al, 1995). The pilot research helps in refining data collection plans with respect to not only the content of the data but also to the procedures to be followed (Yin, 1989). Yin (1989) suggested that the inquiry of the pilot research can be designed to be much broader and less focused than the final data collection plan.

A pilot study was conducted in the light of the study's aims and objectives. The initial aim of the study was to understand how and explain what the environmental impacts of the Libyan Aggregates Industry. Therefore, the primary aim of the pilot study was to explore and investigate the environmental impacts of the aggregate extractions in Libya and the environmental policies and practices and employees attitudes about these policies and practices. Therefore, two groups were to be considered in the pilot study, Aggregate companies and environmental institutions. 108 aggregates companies (51 gravel and crushed rock, 13 sand and 44 building stone) were visited. The choice of these companies was based on the issue of access. Other companies were approached but declined to provide access. Unstructured interviews were conducted with employees in the above mentioned companies. The issue of working permission, environmental impacts and environmental policies and practices was explored. Questions about the government organisations relationships with aggregate industry were raised.

Unstructured interviews were held with the quarry managers, supervisors, administrator and general employees using a form designed to collect the necessary information (See Appendices). These interviews focused on issues related to the type of products, working permission, project size, tax payment, agriculture permission, environmental laws and regulations and health and safety procedure. Interviewees' perceptions about companies' environmental impacts and environmental policies and practices were explored.

The main conjectures induced from these interviews are that the demand for aggregates in Libya has increased over the past two decades, to meet that demand the number of quarries have been significantly expanded, with no consideration of its environmental implications. There has also been extensive exploration of aggregate deposits near urban centres to meet local demand. These developments have caused a lot of environmental problems such as increases in traffic and disturbance of wildlife and vegetation. These conjectures led to the following three main points:

- The first point is related to the relationship between the local authorities and aggregates companies. This led to the consideration of the local authorities as potential participants in this study.
- The second implication of the above conjectures is the role of the environmental institutions as another dimension to this study.
- The third point is the implementation of the environmental laws and regulations in the aggregates industry.

These conjectures and their implications were considered in adopting the research methodology and data collection method(s) suitable for this study.

6.3. Pilot Study Results

In order to identify the environmental impacts of the Libyan aggregates industry, the researcher visited selected sites and some key environmental institutions using a form developed to collect the necessary data (See Appendices). During March and April 2005, the researcher visited quarry sites to investigate the main environmental impact of these quarries (Tables 6.1and 6.2). The Environmental General Authority and the Industrial Research Centre were visited to see how these environmental institutions dealt with these environmental impacts.

No	County name	Gravel and Crushed rock quarries	Sand quarries	Building stone quarries
1	Azawia	-	-	21
2	Sabratah & Surman	-	-	22
3	Nalut	-	2	-
4	Yafran	13	7	-
5	Mizdah	1	-	-
6	Gharyan	10	2	-
7	Ajefarh	6	-	-
8	Tajora & Al-Nuahee Alarbaa	7	-	-
9	Al-Margb	4	1	1
10	Tarhunah & Amslata	8	1	-
11	Bani walid	2	-	-
	Total	51	13	44

Table 6.1 Sites visited by the researcher distributed by county.

As stated earlier, the pilot study was conducted to get knowledge of the Libyan aggregates industry and to assess the effectiveness of government organisations in controlling the aggregates industry and its environmental impacts. In Table 6.2, the visited aggregates sites have been divided into two categories, (Yes) or (No) to each issue of concern e.g. there were 21 building stone quarries in Azawia City, 14 quarry working with permission and 7 working without permission.

Issues / County	Quarry			Permission		Project Size		Tax No		Agriculture Permission		Environmental Law And Regulation		Environmental Impact		Safety And Health Procedure	
	S	CR& GR	BS	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Azawia	-	-	21	14	7	8	13	2	19	1	20	-	21	21	-	-	21
Sabratah & Surman	-	-	22	11	11	7	15	2	20	3	19	-	22	22	-	-	22
Nalut	-	2	-	2	-	-	2	-	2	-	2	-	2	1	1	-	2
Yafran	13	7	-	9	11	10	10	3	17	-	20	-	20	17	3	-	20
Mizdah	1	-	-	1	-	1	-	1	-	-	1	-	1	-	1	-	1
Gharyan	10	2	-	8	4	6	6	2	10	4	8	-	12	9	3	-	12
Ajefarh	6	-	-	1	5	1	5	-	6	1	5	-	6	6	-	-	6
Tajora & Al-Nuahee Alarbaa	7	-	-	5	2	4	3	3	4	1	6	-	7	7	-	-	7
Al-Margb	4	1	1	3	3	2	4	1	5	-	6	-	6	5	1	-	6
Tarhunah & Amslath	8	1	-	3	6	2	7	2	7	1	8	-	9	7	2	-	9
Bani walid	2	-	-	1	1	1	1	1	1	1	1	-	2	1	1	-	2
Total	51	13	44	58	50	42	66	17	91	12	96	-	108	95	13	-	108

S: sand, CR: crushed rock, GR: gravel, BS: building stone

Table 6.2. Fieldwork results, March and April 2005

From the fieldwork results (Table 6.2) the researcher found out that:

1. About 46% of the quarries visited worked without permission.
2. More than half of the quarries had no project map and no indication of project boundaries.
3. The vast majority of the visited quarries had no tax payment record
4. Nearly 95% of the quarries visited were on land designated as agricultural in the planning system.
5. None of the quarries visited had the environmental law or regulation in place and none observed health and safety regulations.
6. In nearly all of the quarries visited, there are significant environmental impacts

These observations suggest that the laws and regulations are generally ignored, leading to a wide range of issues, such as the opening of a quarry without permission or not paying tax.

The absence of a clear role for the environmental institutions has also led to misunderstanding of environmental requirements and has contributed to the environmental impacts at sites visited.

6.3.1 Environmental Impact of the Libyan Aggregate Industry

According to the observations made during the site visits and some of the internal documents collected from the government organisations, the environmental impact of Libyan aggregate quarrying can broadly be categorized as positive impact or negative impact.

6.3.1.1 Positive Environmental Impact

Aggregate quarrying in Libya involves large and small companies that produce aggregate all over the country. Due to the high demand of aggregate in the past two decades, the number of quarries has increased rapidly from 273 quarries in 1991 to 411 quarries by the end of 2003. According to the studies done by the Industrial Research Centre (IRC) in 1991, 1997 and 2003 Figure 6.1and (Table 6.3 appendix1), the number of aggregate quarries has increased since 1991, especially after the sanctions were suspended in 1999. This growth is due to housing projects and building the railway network all over the country.

The industry supports a range of employment in rural areas, both directly at the quarry site (in extraction and processing activities), off-site in haulage activities, and more generally in a range of jobs supported indirectly in the areas by quarrying. In most of the areas, the contribution of aggregate quarrying to overall employment levels in the quarry area is relatively small; this is to some extent due to the small size of quarries. By the end of 2003, there were 411 quarries employing 8580 staff (IRC, 2003), which is equivalent to about 20 staff each, a very small figure compared with the large number of quarries. As 60% of aggregate industry staff work in building stone quarries, however, some aggregates quarries have fewer than 5 staff.

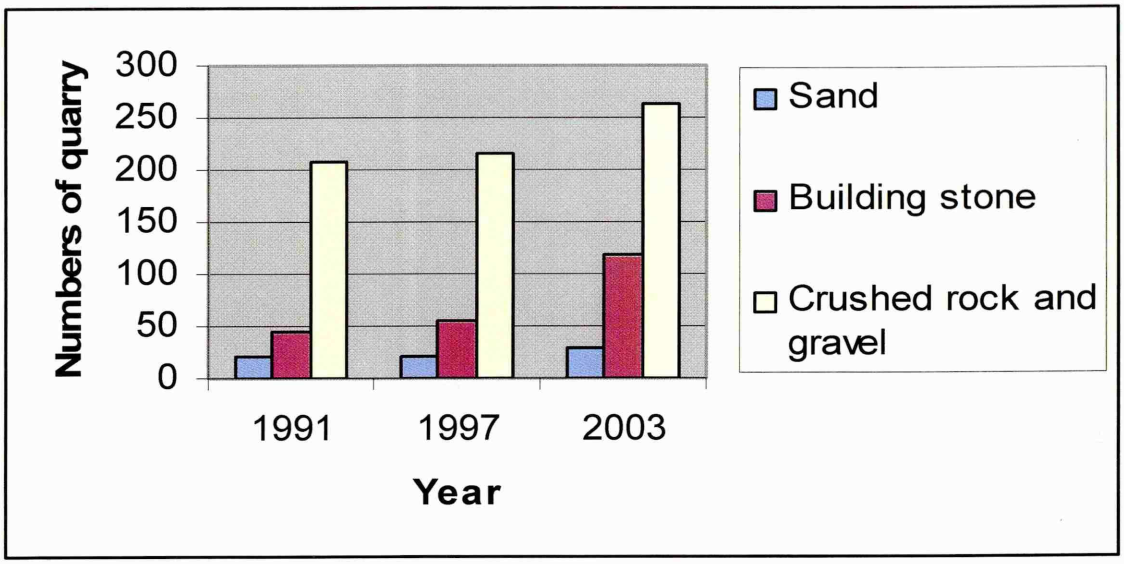

Figure 6.1 Increase of quarry numbers between the 1991 and 2003(IRC, 2004)

From Figure 6.2, it can be seen that the total number of employees in the Libyan aggregate industry increased since 1991, increasing sharply after 1999. According to some quarry owners, this sharp increase is due to an increase in housing and roads projects

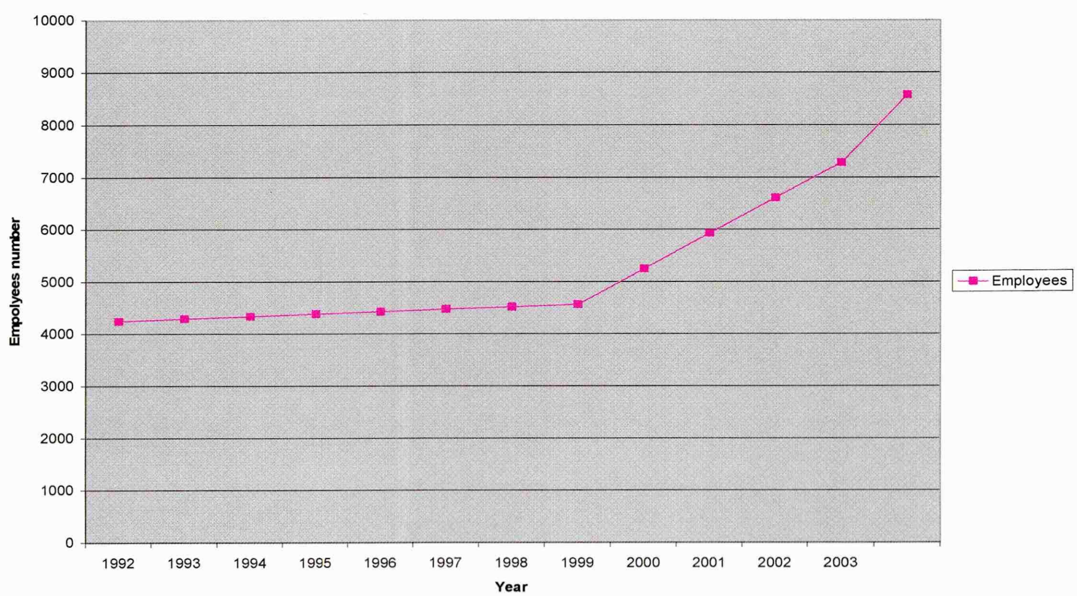

Figure 6.2. Increase in employment in the Libyan Aggregate Industry (IRC, 2004)

6.3.1.2 Negative Environmental Impact

The fieldwork showed that none of the sites visited had implemented environmental laws and regulations. Aggregate extraction in Libya is, therefore, uncontrolled and, as a result, the industry creates various environmental impacts.

During the site visits it has been noticed that environmental protection awareness in the aggregates companies and the government organisations' is very weak and the staff knowledge of environmental protection is limited due to absence of an environmental department. Additionally there were no systems to allow the employees to make their own feelings about environmental impact known or to report environmental impact incidents.

6.3.1.2.1 Impacts Due to Blasting:

One of the most frequent complaints the public makes to the quarrying industry situated near population centres is about blasting noise and vibration (National Academy of Sciences, 1980). Blasting may occur daily or once or twice a week.

From the fieldwork, it seems that about 40% of the sites visited use blasting in their work and that the environmental impact of blasting is very serious because of the erratic distribution of quarries and their inevitable closeness to residential and commercial areas.

The most obvious impact caused by blasting is vibration, fly rock, noise and dust. According to some of the quarry neighbours, the use of heavy explosives in these quarries is a major cause of public concern especially around quarries located close to communities, as can be seen from Plates, 6.1, 6.2, 6.3, 6.4 and 6.5 and in the national parks and natural beauty areas seen in Plates 6.1 and 6.4.

There are also a number of quarries located very close to main roads (see Plates 6.5 and 6.6). In some of these quarries, blasting is the only way to loosen the rock. Using explosives in these quarries causes a lot of environmental problems such as fly rock, dust and noise which is very dangerous for the roads users.

6.3.1.2.2 Dust:

Dust is one of the most visible, invasive, and potentially irritating impacts associated with quarrying (Howard and Cameron, 1998). The environmental impact of dust from the quarrying activity in Libya is the most noticeable effects in all the visited sites. This dust comes from blasting, poor use of equipment, transportation and bad quarry roads.

In all the sites visited, the effect of dust is the main environmental impact. The dust generated by Libyan aggregate extraction can be divided as follows:

1. Impacts on surrounding areas, especially within about 2 km of the quarry site (as can be seen from Plates 6.9, 6.10, 6.11 and 6.12).
2. Impacts on residential areas close to the quarry site or along the transport routes (Plate 6.13).
3. Impacts on plants, vegetation and wildlife. Dust is one of the main reasons, if not the only reason, for killing a wide range of plants and vegetation and the displacement of wildlife from the area around the sites visited (Plates 6.12, 6.13 and 6.14).

4. Impacts on health, as can be seen from Table 6.3 that in all the sites visited the absence of health or safety procedures, which will raise the possibility of health problem such as impact of dust to the quarry staff (Plate 6.15 and 6.16).

6.3.1.2.3 Noise:

The primary source of noise from extraction of aggregate is equipment movement, processing, and blasting. The truck traffic that often accompanies aggregate quarrying can be a significant source of noise. The impacts of noise are highly dependent on the sound source, the topography, land use, ground cover of the surrounding site, and climatic conditions (Langer, 2001).

The impact of noise in Libyan aggregate quarries occurs during exploration, drilling (crushed rock and gravel quarries only), processing and transportation. The impacts are exacerbated by the poor location of quarries close to settlements, the transport by road of aggregates for processing or to points of use, and the poor condition of roads. From the fieldwork, it appears that the impact of noise from aggregate extraction is due to the following:

1. The poor location of quarries and their closeness to residential and commercial areas (see Plates 6.1, 6.2, 6.3, 6.4 and 6.5).
2. The transport of the aggregates by truck to processing facilities or to points of use causes major noise impacts along transport routes (see Plates 6.17 and 6.18).
3. The majority of the visited quarry sites use poorly maintained equipment (see plates 6.9 and 6.46).

4. There is no fixed work timetable in the sites visited, which means the work could be any time.
5. The roads at the vast majority of sites visited are in poor condition and are unsuitable for large Lorries (see Plate 6.24).

6.3.1.2.4 Visual Impacts:

Libyan aggregate quarrying produces a number of visual impacts, including dust impacts on the local vegetation cover, poor restoration of sites and loss of soil and natural resources. From the fieldwork, the visual impact of Libyan aggregate working can be characterized as follows:

1. Impacts on local vegetation cover: there are a number of visited quarries located in national parks or natural beauty areas, as can be seen from Plates 6.19 and 6.20.
2. Impacts on wildlife and local communities: in most sites visited, the work condition is very poor due to bad equipment and machinery used which creates noticeable impact to the wildlife and the local communities around the site and along transport routes, as can be seen from Plates 6.2, 6.11 and 6.14.
3. The poor restoration of sites: many of the sites visited have been left open without restoration or uncompleted restoration, as can be seen from Plates (6.21, 6.22, 6.23, 6.24 and 6.25).
4. The loss of soil and natural resources: in all sites visited there are clear impacts on top soil and a waste of natural resources which could lead to resource depletion (see Plates 6.19, 6.23 and 6.25).

6.3.1.2.5 Water:

Quarrying in the unsaturated zone is likely to result in local impacts such as increased runoff, reduced water quality, rerouting of recharge water through the aquifer, and localized reduction in groundwater storage.

The impact on the water environment is limited to groundwater as there are no rivers or surface water in Libya. The impact on groundwater is associated with oil and fuel spills, especially where sites are left without restoration, and sea water intrusion. From the fieldwork and discussion with staff in the Water General Authority, it has been found that the environmental impact of the Libyan quarrying industry to the groundwater comes from the following:

1. Oil and fuel spills: in the vast majority of the sites visited, the oil and fuel storage facilities are in bad condition due to corrosion or leaks which lead to oil and fuel spills (see Plates 6.26, 6.27, 6.28 and 6.29).
2. Sites left without restoration: there are many quarries left open without restoration (see Plates 6.32, 6.33 and 6.34). As a result, some of these quarries becoming dump sites, which affects the groundwater in the quarry area.
3. Sea water intrusion: many of the sites visited, especially building stone quarries, extracted rock below sea level, causing sea water intrusion into fresh water aquifers (see Plates 6.39, 6.40, 6.41 and 6.42).

6.3.1.2.6 Traffic:

Transportation of quarried material by trucks to their various destinations also has its effect on the environment. All products from aggregate quarries in Libya are transported by road because there is no railway network. This causes a lot of environmental impacts, such as the number of trucks on the road, spills of material on the road from overloaded trucks, the road is narrow and unsuitable for large tracks and bad condition of trucks which produces noise, emissions, oil and fuel spills. The most obvious traffic impacts in the Libyan quarrying industry are:

1. The numbers of trucks in the road, as can be seen from Plate 6.18.
2. Spills of material on the road from overloaded trucks (see Plates 6.43 and 6.44).
3. The quarry roads pass towns and villages in most of the sites visited and these roads are very narrow and unsuitable for large trucks (see Plate 6.24).
4. Bad condition of trucks used in quarry sites which produces noise, emissions, oil and fuel spills, as can be seen from Plate 6.46.

6.3.2 Contributory (Factors) to the Environmental Impacts

From the above discussion, it can be said that the Libyan aggregate industry is not controlled or the organisations monitoring and controlling the quarrying industry are incapable to stop its environmental impacts and also there are a number of management problems in government organisation and aggregates quarries. Factors contributing to the poor environmental performance of the industry include the following.

6.3.2.1 Permission:

During the field visit four types of permission were identified; permission from local authority, county governments, Ministry of Industry and Ministry of

Transportation. Also there were large numbers of quarries working without permission see Table 6.2, and that lead to:

- Working in very sensitive areas such as national parks
- No environmental regulation and health and safety procedure
- May employ unqualified employees or produce aggregates does not meet the standard specification.
- Waste of materials and depletion of resources
- Destruction of landscape and loss of agriculture soil.

6.3.2.2 Environmental Laws and Regulations

The environmental laws and regulation are not implemented in the aggregates industry and this could be due to the following:

1. Lack of budget in the aggregates companies;
2. Lack of help from government organisations to the aggregates industry to implement the environmental laws and regulations;
3. Lack of government courses and training to the aggregates industry staff;
4. Lack of government guidance on the latest environmental laws and regulations.

6.3.2.3 Environmental Managements System (EMS)

The environmental management system (EMS) is a tool defining a formal and structured approach to enable organizations to systematically control and reduce their environmental impact. During the field visit the aggregates industry and the government organisations were examined to gauge the level of environmental awareness and its practices in both of them also to ascertain their views on the implementation of an EMS. What has been found from the field visit is that:

1. Large numbers of quarry staff and governments organisation's employees do not have knowledge about environmental protection and the EMS;
2. The EMS is not implemented in the aggregates industry due to various reasons such as high implementation cost and lack of training;
3. There was no pressure from the government to implement EMS;
4. There was no evidence of help or support from the government to implement EMS.

6.3.2.4 Local Authorities:

Local authorities play a vital role in delivering public services in Libya but ignoring laws and regulations and the lack of qualified staff leads to:

1. A degree of uncertainty about the role of local authorities to improve the communities they serve;
2. Misunderstanding of environmental degradation caused by the permission that they have granted;
3. Ignorance of any projects (e.g. quarrying) started without permission;
4. Lack of community involvement in decision making.

6.3.2.5 Environmental Institutions:

The Libyan environmental institutions were formed to protect people and the environment but from the fieldwork, it appears that the environmental institutions in Libya have not been effective in enforcing established environmental law and regulations and this could be due to:

1. Lack of qualified staff;

2. There is no master plan for environmental protection training and development which can be used as guidance when training policies are formulated in the aggregates industry and the government organisations;
3. Lack of facilities such laboratories, measuring equipment etc...
4. Lack of budget;
5. Misunderstanding of their roles and responsibility, which has been stated in chapter two;
6. Some of the environmental institutions have only one office in Tripoli (The Capital) which makes the work very complicated due to travel distance.

6.3.3 Questions Developed From the Fieldwork

From the fieldwork, the researcher found out that the environmental impact of the Libyan aggregate Industry is very serious. This leads the author to ask the following questions:

Q1: Why are so many quarries working without permission?

Q2: Why are the environmental impacts from the aggregates industry not controlled and what role has the planning system had in allowing these impacts to continue?

Q2: Why are Libyan environmental laws and regulations not effective?

Q4: Why aren't the local authorities and environmental institutions more effective in protecting the environment?

The above questions will be answered in the next chapter using the questionnaire and interview.

6.4. Chapter Summary

This chapter has reviewed the observations made during the field visit to the Libyan aggregate industry and environmental institutions during March and April 2005.

The demand for aggregates in Libya has increased over the past two decades. To meet that demand a number of quarries have been significantly expanded, causing a lot of environmental impacts such as increases in traffic, dust, noise, and disturbance of wildlife and vegetation.

Evidence gathered from these visits includes documentary material from the case study organisations, photographs from the visited sites showing their environmental impacts, and the author's own observations about the industry. Those observations, documentation and all the information gathered in this chapter will be used to develop the questionnaires and interviews presented in the next chapter.

6.5. Fieldwork Plates

Plate 6.1 The impact of quarrying in housing and residential areas. The proximity of the quarry site to the residential area is clearly shown in the photograph. Also This quarry in Nagaza national park shows poor material extraction and the absence of safety procedures.

Plate 6.2 The impact of quarrying in housing and residential areas. From the photo it can be seen that the quarry is situated in the middle of town and very close to mosque.

Plate 6.3 The impact of quarrying in housing and residential areas includes the potential for noise impact.

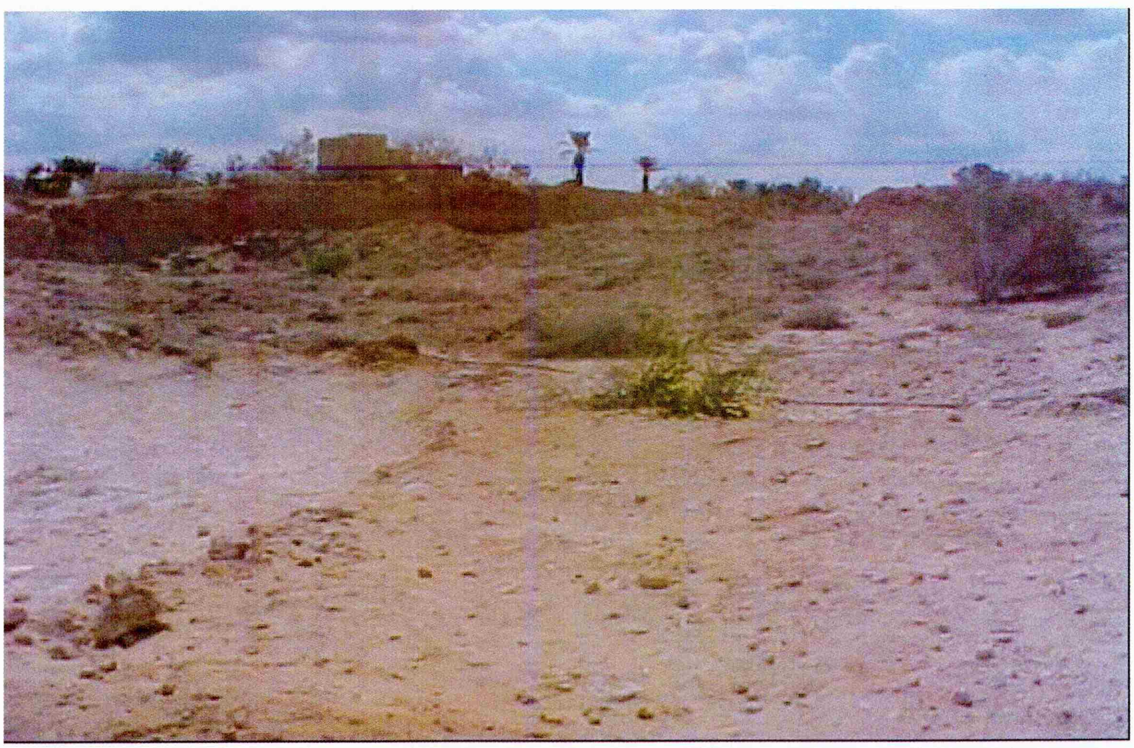

Plate 6.4 The impact of quarrying in Surman national park. The top-soil and vegetation have been removed by quarrying and this has led to soil erosion and desertification

Plate 6.5

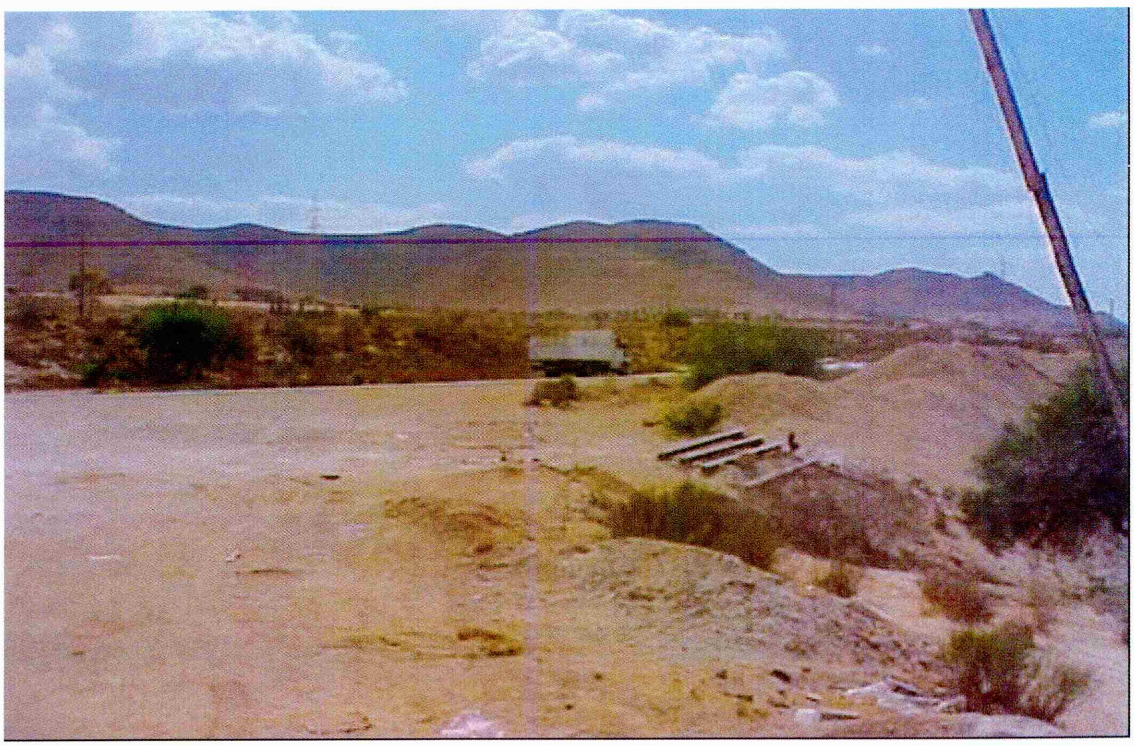

Plate 6.6

Plates 6.5 and 6.6 The impact of quarrying on public roads includes the potential for dust and blasting (fly rock) impacts where quarrying takes place very close to main roads.

Plate 6.7 The impact of quarrying dust arising from the handling and processing of aggregate, the loading of ore and rock and the movement of vehicles.

Plate 6.8 The impact of dust from concrete plant. The quarry is highly mechanised as can be seen in this view from inside the site, with dust arising from the handling, processing and grading of aggregates.

Plate 6.9

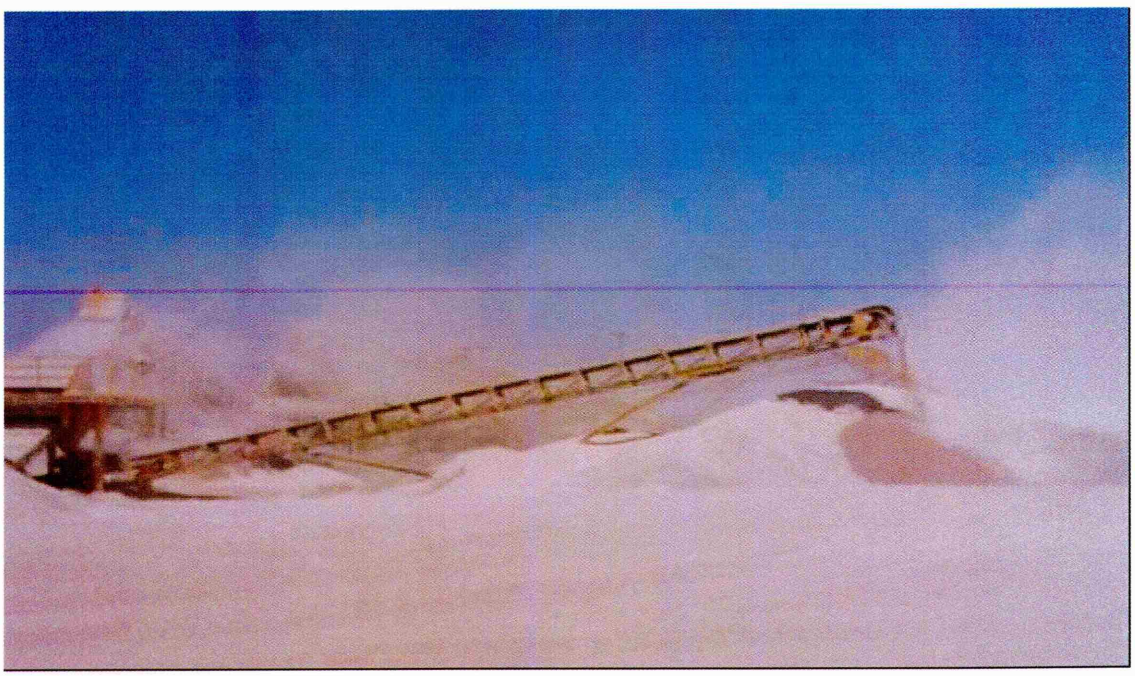

Plate 6.10

Plates 6.9 and 6.10. The impact of quarrying dust arising from the handling and processing of aggregate.

Plate 6.11 The impact of quarrying on agriculture land showing clearly how far dust can travel from the site by wind.

Plate 6.12 Dust impact on plants and vegetation.

Plate 6.13 The impact of quarrying on agriculture land. This quarry is situated in the middle of a farm and, as a result, a large area of the farm has become unsuitable for farming, with half of the farm trees killed by quarrying impacts such as dust.

Plate 6.14 Dust impact on plants and vegetation along a transport route.

Plate 6.15 The impact of quarrying dust on quarry employees. In all the visited sites there was no health and safety equipment for the workers, as can be seen in the photo in which workers are trying to protect themselves by using cloth to cover their faces and heads.

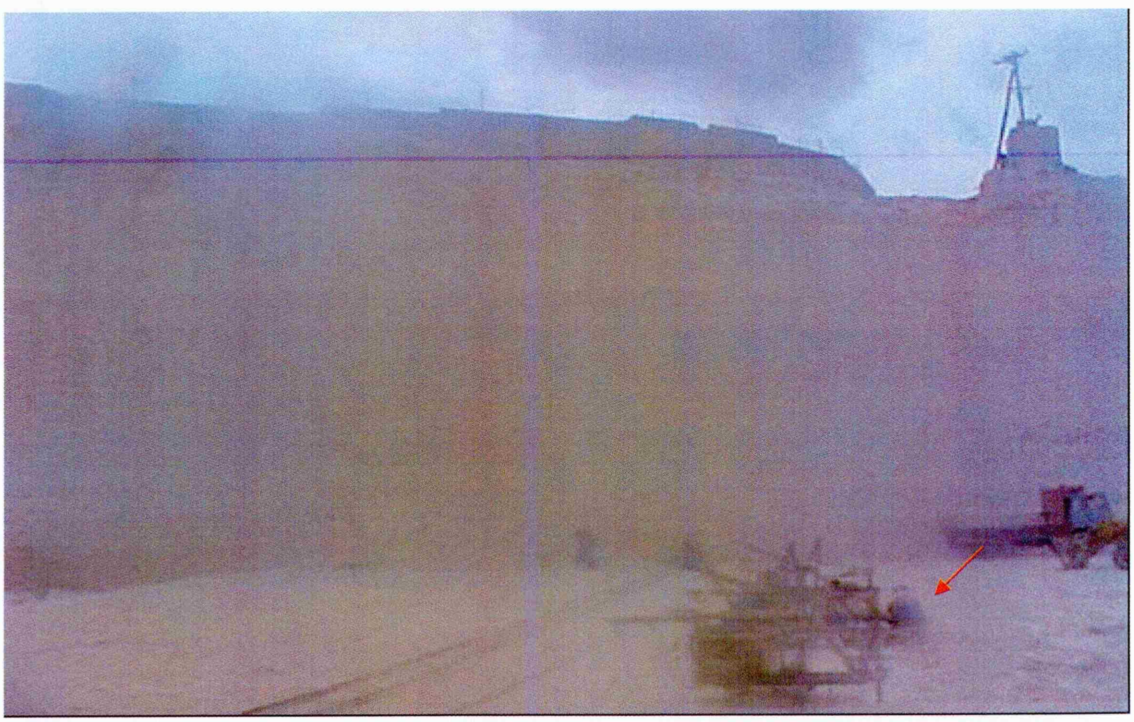

Plate 6.16 The impact of quarrying dust on quarry employees. In all the visited sites there was no health and safety equipment for the workers, as can be seen in the photo in which workers are trying to protect themselves from dust.

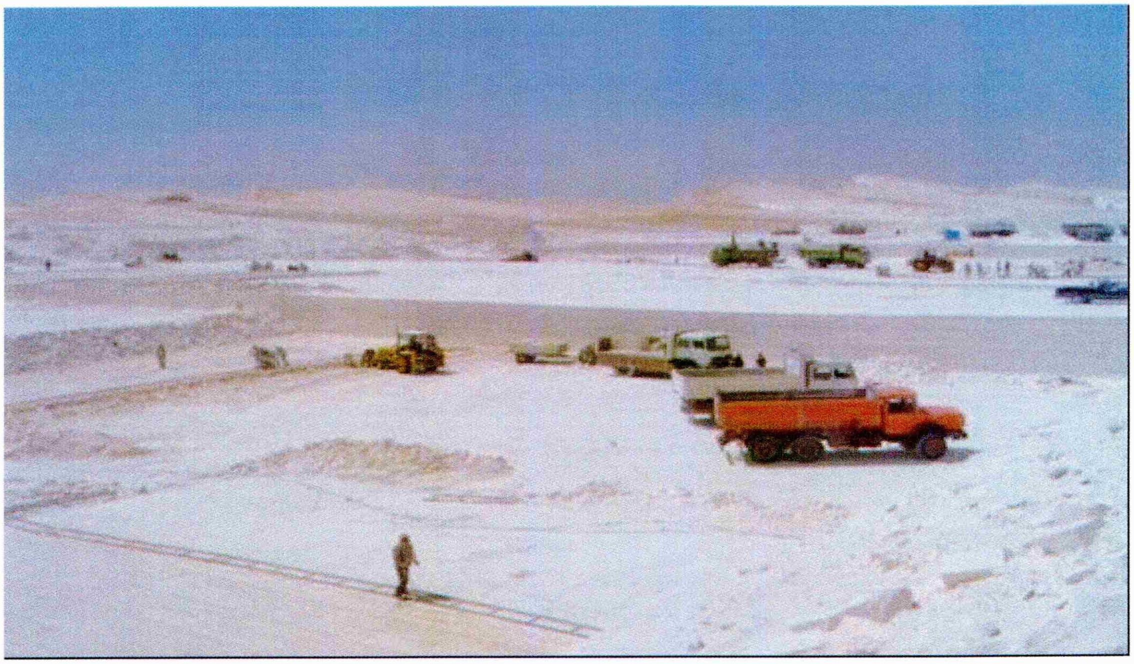

Plate 6.17

Plate 6.18

Plates 17 and 18 The potential for noise impact due to high numbers of trucks in the quarry site.

Plate 6.19 The impacts of quarrying in Kouff national park and natural beauty areas includes visual impacts and the potential for erosion due to removal of the top soil and overburden.

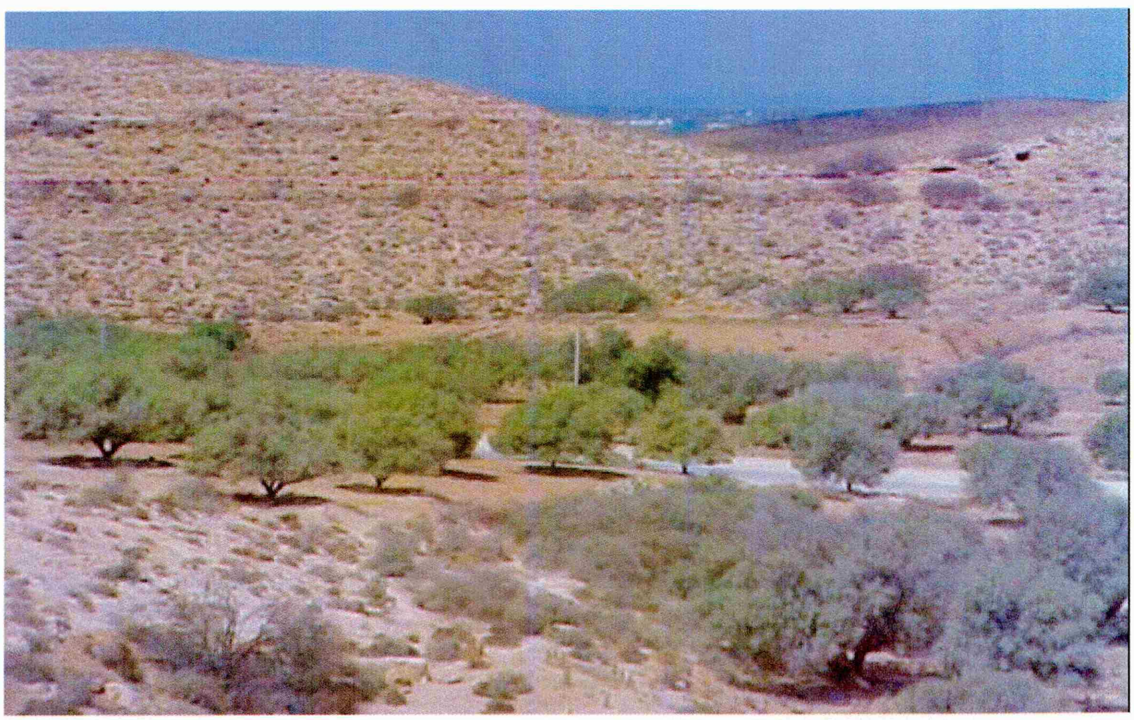

Plate 6.20 The impacts of quarrying in national parks and natural beauty areas includes visual impacts and the potential for dust and erosion due to removal of the top soil and overburden

Plate 6.21

Plate 6.22

Plates 21 and 22 The visual impact of quarrying. Quarry site abandoned without restoration.

Plate 6.23 The visual impact of quarrying. Quarry site abandoned without restoration. In this plate it can be seen loss of sand resources due to bad extraction.

Plate 6.24 The visual impact of quarrying and landscape degradation by quarrying activities

Plate 6.25 The visual impact of quarrying. Quarry site abandoned without restoration with loss of soil and materials due to bad working plan.

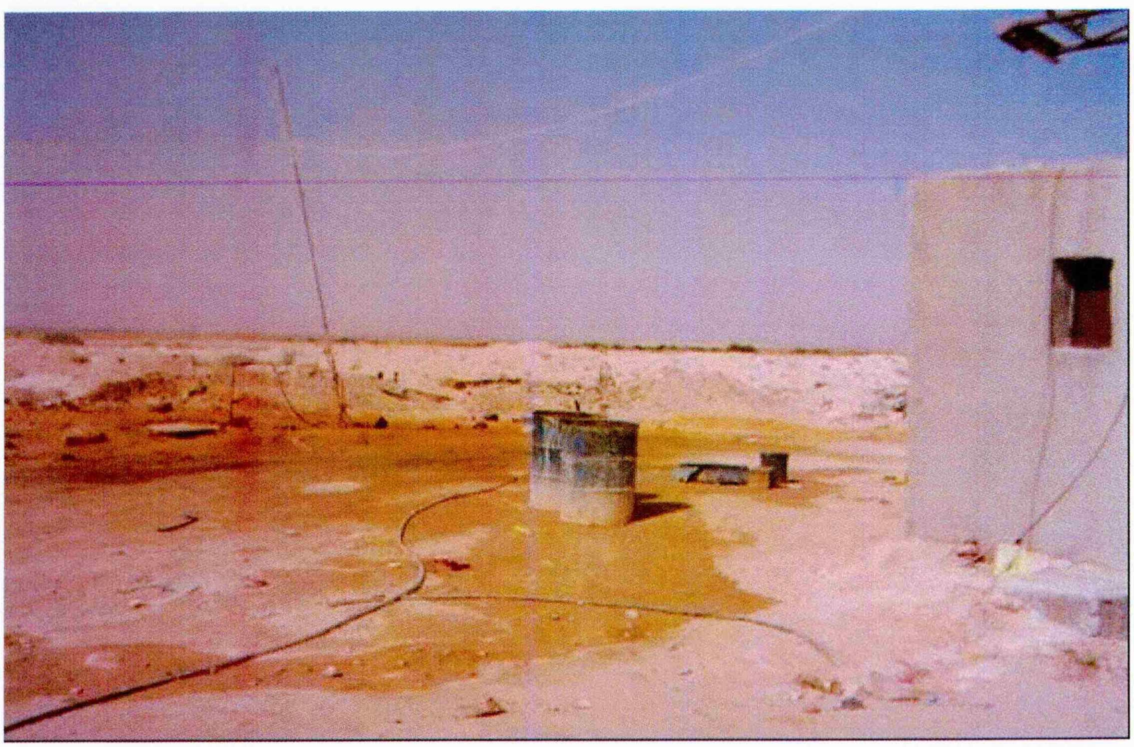

Plate 6.26 Potential impacts on soil and water environments due to oil and fuel spills from poor storage facilities.

Plate 6.27

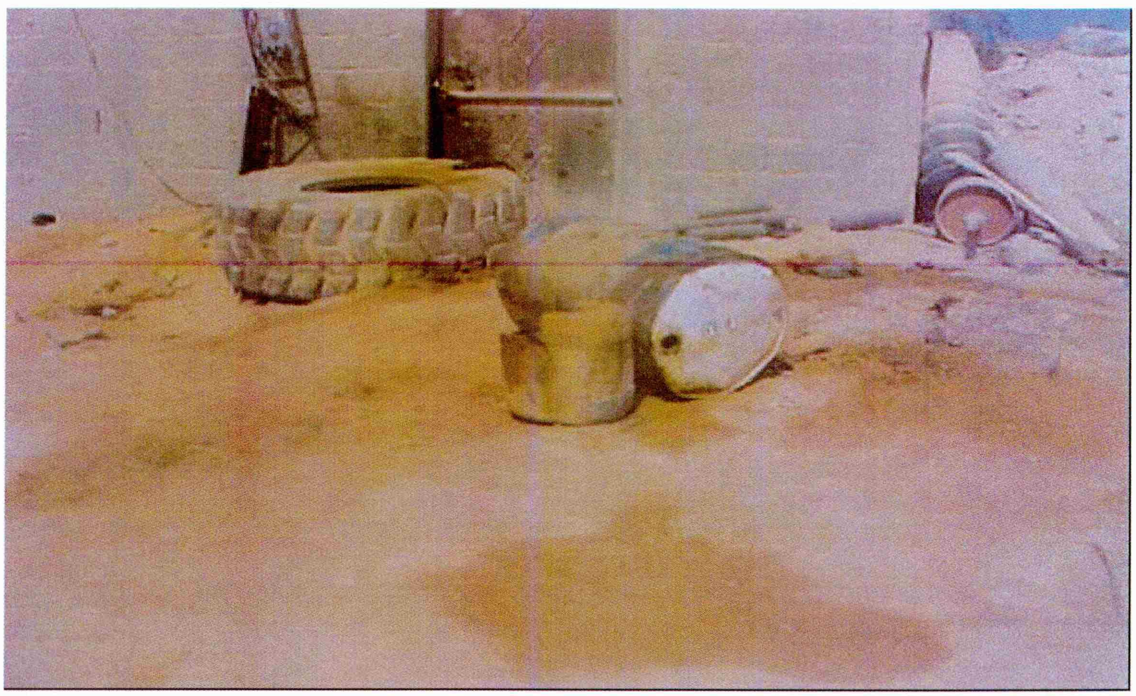

Plate 6.28

Plate 27 and 28 Potential impacts on soil and water environments due to oil and fuel spills from poor storage facilities.

Plate 6.29 Potential impacts on soil and water environments due to oil and fuel spills from poor storage facilities.

Plate 6.30 Quarry site developed as waste disposal site. This quarry is about 10 m from the sea and will potentially cause impacts to the beach.

Plate 6.31

Plate 6.32

Plates 6.31 and 6.32 Quarry sites developed as waste disposal sites will potentially cause a number of issues such as impact to landscape and ground water.

Plate 6.33

Plate 6.34

Plates 33 and 34 Abandoned quarry becoming a waste disposal site.

Plate 6.35

Plate 6.36

Plates 35 and 36 Abandoned quarry becoming a waste disposal site.

Plate 6.37

Plate 6.38

Plates 37 and 38 Abandoned quarry without restoration.

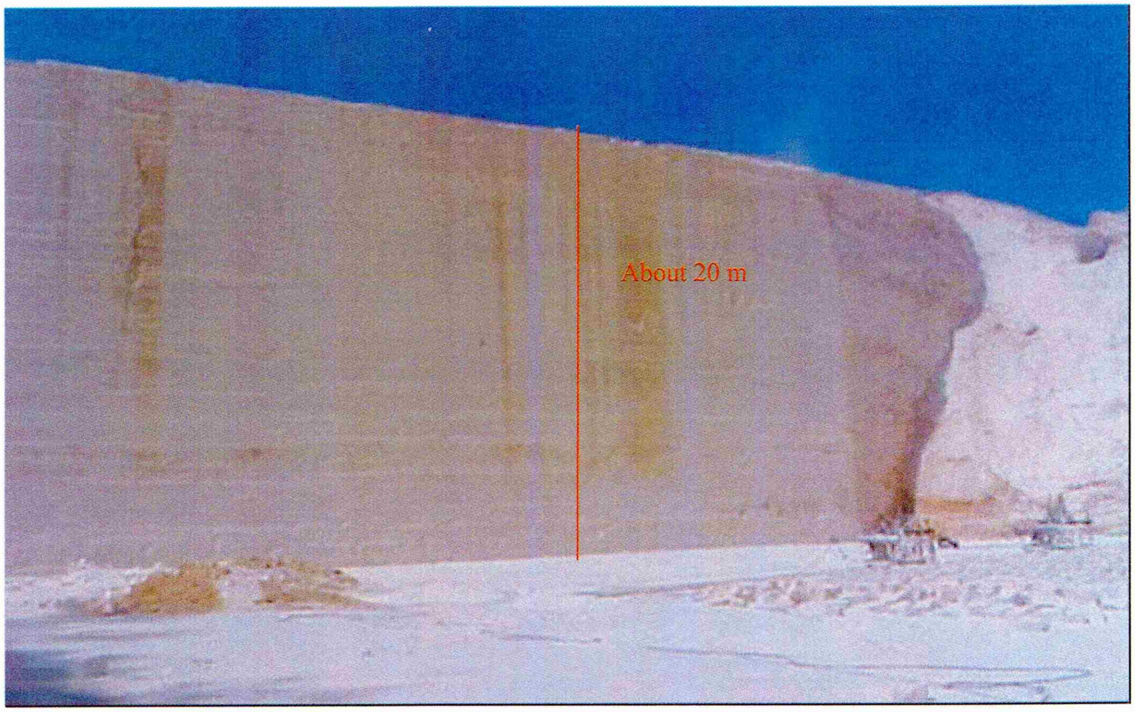

Plate 6.39

Plate 6.40

Plates 6.39 and 6.40 Impact of quarrying on groundwater due to extraction of material below sea level, causing sea water intrusion and salination of groundwater.

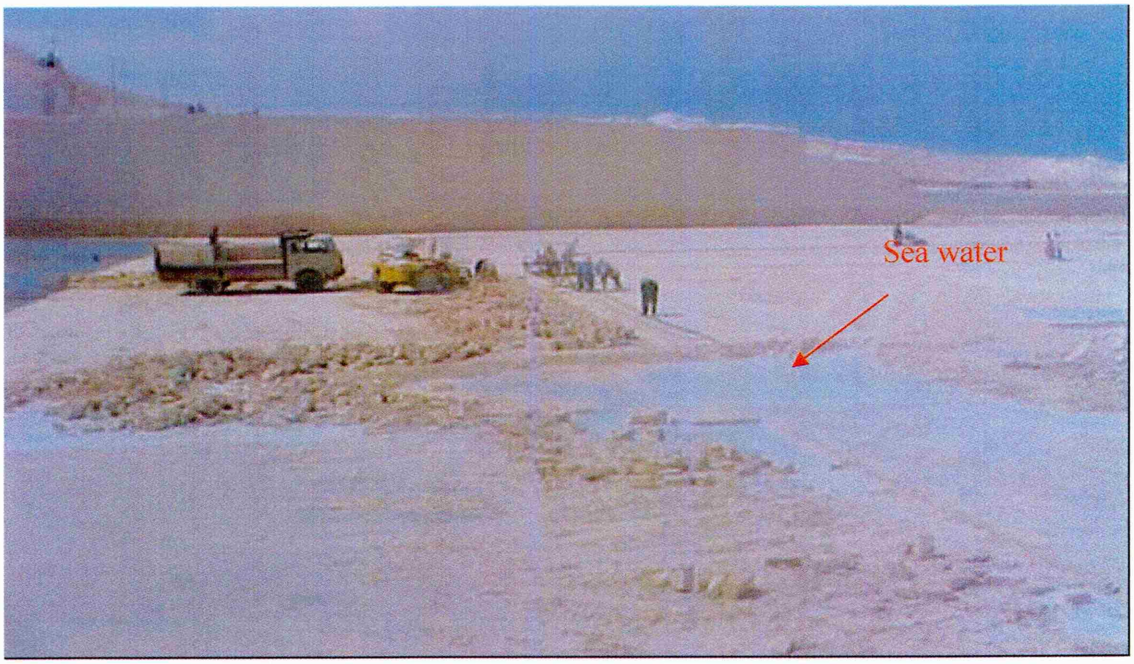

Plate 6.41

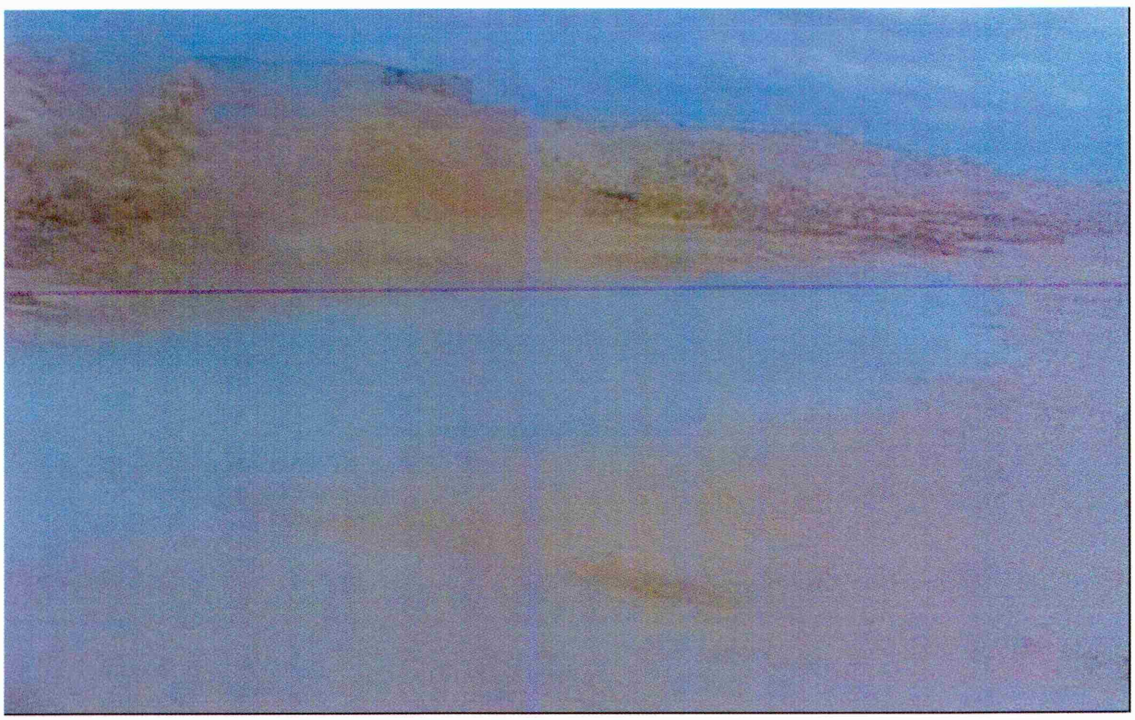

Plate 6.42

Plates 6.41 and 6.42 Impact of quarrying on groundwater due to extraction of material below sea level, causing sea water intrusion and salination of groundwater.

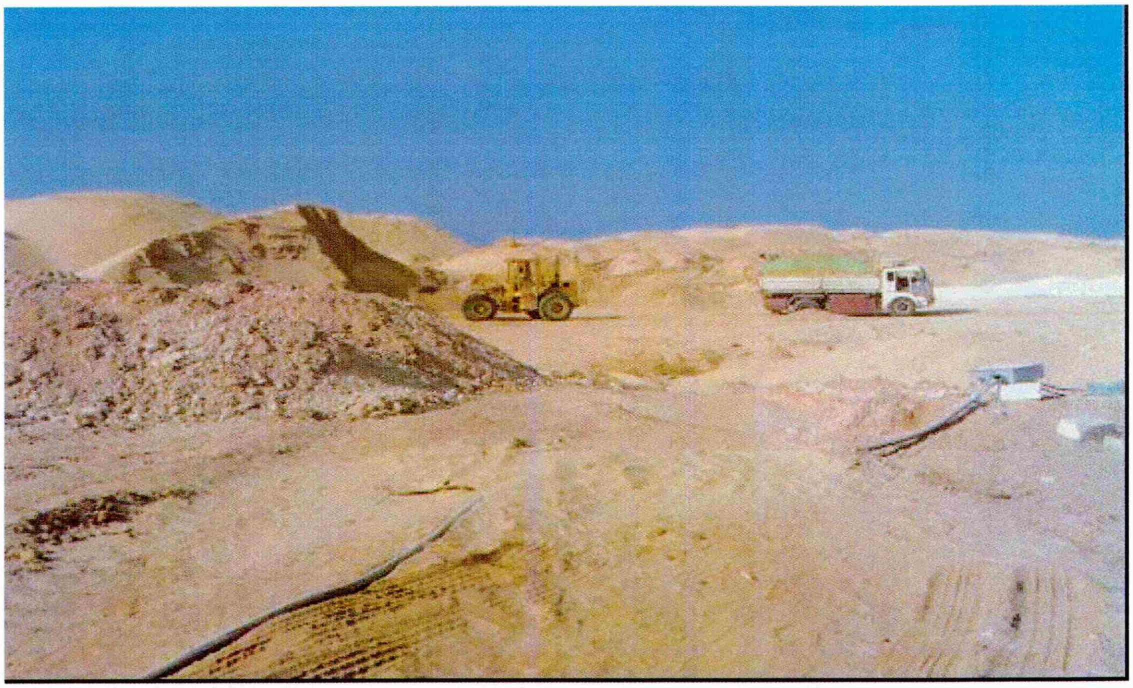

Plate 6.43

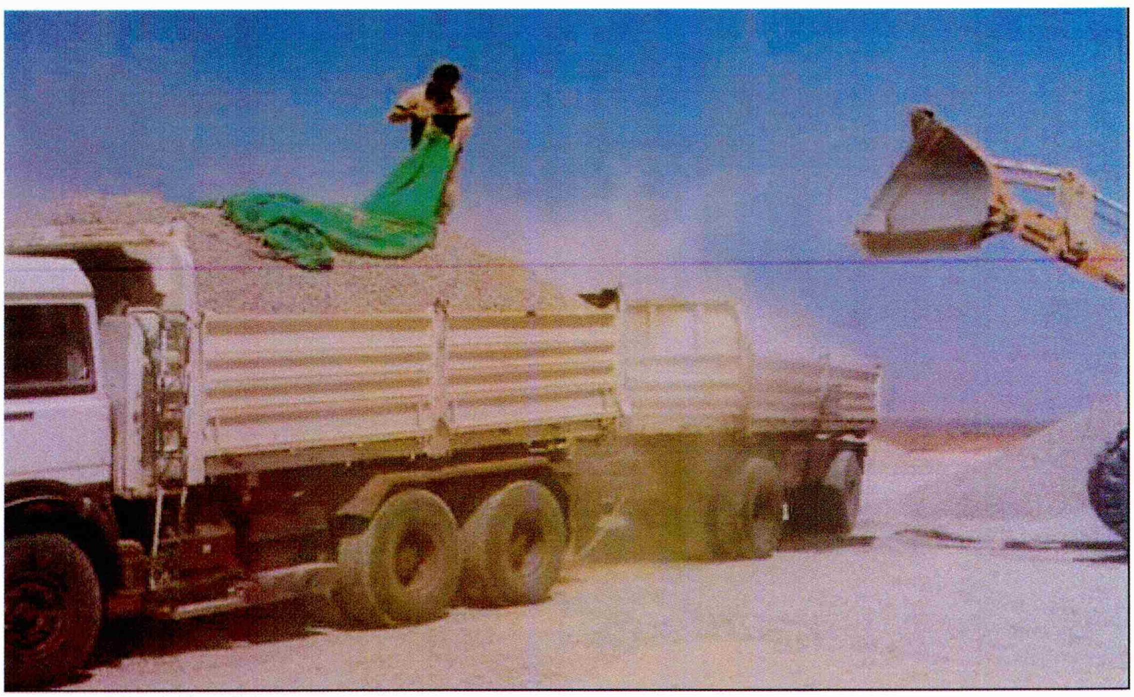

Plate 6.44

Plates 6.43 and 6.44 Overloaded trucks cause material spills and damage to the road.

Plate 6.45 Impact of quarrying due to extraction of sand from the beach.

Plate 6.46 Poor condition of trucks will potentially cause noise impact and oil and fuel spills.

CHAPTER SEVEN

Chapter Seven
Questionnaire and Interview Findings

7.1. Introduction

As mentioned in Chapter Six the main sources of data used in this study are questionnaires and interviews. The questioning in the questionnaires and interviews was based on the information gathered from secondary data and documentation and on fieldwork observations made in March and April 2005 and presented in Chapter Six. The methodology for this study was discussed in Chapter Five, together with decisions relating to the appropriate data collection methods, how these methods were developed, how data were collected and how they are going to be analysed. The data were collected by submitting the questionnaire to quarry staff and by interviewing government organisation employees (Environmental General Authority, the local authorities and the Industrial Research Centre) to gather opinions and views on both the environmental impact of aggregate extraction and the role of the government organisations in controlling those impacts. The next step was to analyse the collected data and to present the results. This chapter aims to present the results of the questionnaires and interviews and these findings, along with the field evidence, will be discussed in Chapter Eight.

7.2. Interviews and Questionnaires

The field study's objectives were to conduct a survey of the environmental impact of aggregate extraction in Libya. More specifically, the fieldwork sought to survey the opinion and views of government organisation employees and the quarry staff on:

- The environmental impact of aggregate extraction;
- The current environmental laws and regulations and their implementation;
- Whether or not the current licensing procedure is adequate;
- The role of government organisations in the field of environmental protection.

7.2.1 Survey Methodology:

The survey was carried out with the help of three people. The first works in the Environmental General Authority as a department manager. The second works in the Industrial Research Centre as inspector. The third works in the local authority as head of the licensing section. The environmental impact of aggregate industry survey (questionnaire and interview) was carried out during March and April 2006. This was a suitable time to make contacts with the government organisations before the summer holiday.

7.2.2 The Quarry Staff Questionnaire

According to the physical survey, it was found that the Libyan aggregate industry consisted of three types of products (rock, building stone and sand and gravel), so it was decided to investigate quarries producing each type of product. Questionnaires were distributed to 108 aggregates companies (51 gravel and crushed rock, 13 sand and 44 building stone). The target sample was 45 questionnaires completed by quarry staff.

The researcher received 36 completed questionnaire forms, which indicates a very high rate of response (Table 7.1).

Quarry type		Completed
1	Rock	12
2	Building stone	13
3	Sand and gravel	11
	Total	36

Table 7.1 : The Completed Questionnaire Divided by Type of Quarry

7.2.3 The Interview of Government Organisation Employees

40-50 employees from the three case studies (Environmental General Authority, Industrial Research Centre and local authority) were the target for interview. The author considered three conditions for selection. The first is to be a Libyan national; the second is to be involved in or to have knowledge about the aggregate industry; and the last condition is that he/she has experience in the field of environmental protection for at least 5 years. To arrange a suitable time for the interview, initial approaches were made either by telephone or office visit. In a few cases, some of these interviewees had to cancel the appointment because of urgent work or another reason.

At the end, 30 interviews were completed. The interviews were conducted in respondents' offices. Each interview was about 40-45 minutes in length; a tape-recorder was used, where the interviewee agreed. Checking the completeness and consistency of the questionnaires and interview forms was made daily after the collecting process. The revision of the forms was made according to the author's own system and daily progress was recorded.

7.2.4 Complementary Information:

During the fieldwork additional relevant information was also collected from different sources and by means other than interviewing, as follows:

I- Some complaint papers from neighbouring residents or land owners of the quarry sites that had been sent to the local authority and Environmental General Authority.

II- Remarks and observations pertinent to the purpose of the study were carefully recorded.

III- A large number of photographs were taken of the most visited sites to help the author assess and analyse his data.

7.3. Coding and Data Analysis:

The researcher used SPSS computer program (The Statistical Package for the Social Sciences) for analysis of the data obtained from the questionnaire and interview. The data from government organisation employees and quarry staff responses were computed both overall and by job position and then tabulated in statistical tables and presented in the form of statistical charts and diagrams. Such presentation would help the reader to appreciate visually the salient characteristics of the data and can also suggest the type of statistical treatment. As mentioned earlier, during his first visit (March and April 2005) the author made good connections with the three case studies and a large number of the quarry owners. This gave the author a good chance of interviewing a lot of experienced people in the three case studies and allowed the questionnaire to be completed.

In the interview, where some of the questions were designed as open-ended, data were recorded on paper and then classified into categories. The data obtained from these questions was analysed qualitatively.

The first stage of the data analysis involves observing, sorting and grouping the data. To enable this, all data obtained from the interviews and questionnaires were transferred into a Microsoft Excel programme. Double checking the data entry was carried out throughout the process to avoid any error during the transfer. A total of 66 results comprising 30 government organisation employees and 36 quarry staff were selected and transferred into the SPSS Version 13 software for analysis. The detailed breakdown of the respondents used in the analysis is shown in Tables 7.2a&b and Table 7.3.

Respondent Types	Number of Respondents
Quarry Manager	**14**
Supervisor	**4**
Administrator	**3**
General Employee	**15**
Total	**36**

Table a: The Questionnaire Respondents

Respondent Types	Number of Respondents
Administrator	**3**
Inspector	**10**
Department Manager	**9**
Senior Manager	**8**
Total	**30**

Table b: The Interview Respondents

Table 7.2 a & b: The survey respondents

Interviews Respondents Codes					
EGA		IRC		Local Authorities	
Respondent	Code	Respondent	Code	Respondent	Code
Administrator	AD1	Inspector	IS6	Administrator	AD3
Administrator	AD2	Inspector	IS7	Inspector	IS8
Inspector	IS1	Department Manager	DM4	Inspector	IS9
Inspector	IS2	Department Manager	DM5	Inspector	IS10
Inspector	IS3	Department Manager	DM6	Department Manager	DM7
Inspector	IS4	Senior Manager	SM4	Department Manager	DM8
Inspector	IS5	Senior Manager	SM5	Department Manager	DM9
Department Manager	DM1			Senior Manager	SM6
Department Manager	DM2			Senior Manager	SM7
Department Manager	DM3			Senior Manager	SM8
Senior Manager	SM1				
Senior Manager	SM2				
Senior Manager	SM3				

Table 7.3 The Interview Respondents Codes

The main steps in the data analysis were:

a) Frequency distribution: this is considered to be a simple means of exploring data by showing the frequency and the percentage of the variable categories.

b) Measure of association: cross-tabulations were used to show the association between the variables.

7.4. Case Study Findings

This section presents the primary data collected in the field survey to answer some questions of this research. These data are presented in tabular form followed by discussion on the salient features.

The procedures for the collation and analysis of data included the initial data analysis, in particular examination of the frequency distribution, cross tabulation and percentage figures using SPSS computer program for analysing data obtained form the questionnaire and the interview. However, to give a clear picture of each job position, the majority of tables give the frequency distribution in the form of number and percentages of total number of each position type as well as the total number of the sample.

In the government organisations employees' interview, where some of the questions were designed as open-ended, data were recorded on sheets of paper and then classified into categories. The data obtained from these questions were analysed qualitatively.

7.5. The Quarry Staff Questionnaire

This part of the study reviews the results of the quarry staff questionnaire. Each question is taken separately. Firstly, responses given by all the 36 staff are considered as one group; secondly, they are divided into the four job types that comprised the survey.

7.5.1 Data Collection Methods

Fifty questionnaires were distributed to the quarry staff. Thirty six questionnaires were collected. The aim of the questionnaires is to obtain the following five kinds of information about the quarry workers and the quarrying industry:

1. Information about the status of operation;
2. Information about the environmental impact of the industry;

3. Quarry staff awareness of the environmental laws and regulations in Libya in general;
4. Quarry staff opinions on the local authority role in the field of the environmental protection;
5. Quarry staff opinions on the environmental institutions' role in the field of the environmental protection.

The questionnaire questions have been built from the pilot study (Chapter Six) and used to guide and develop the interviews. Furthermore, the researcher was given permission to review some of the aggregates company's documents such as production and sales reports and annual reports. Other data were collected by being present in the company and being involved in informal talks with employees.

7.5.2 Data Analysis

The data collected by questionnaires were analysed using SPSS Software to explore the opinions and views of the respondents about the environmental impact of aggregate extraction and their understanding of the environmental laws and regulations and their opinion about the government organisations role in the field of environmental protection. Data from the fieldwork were used to support the analysis and provide more understanding of the aggregates industry.

7.5.3 The Status of Operation (Questions 1-5)

This section will examine the quarry in terms of its operational status, permission duration, from which authority, etc. The opinions of the quarry staff about it provide some valuable information.

7.5.3.1 Quarry Staff and the Licence of their Quarry

Respondents were asked whether they have a permit/ licence in their quarry or not. As seen in Table 7.4, 100% of the administrator say they have a permit/ licence in their quarry, 75% of the supervisors say they have a permit/ licence, also 42.9% respondents of quarry managers indicate that they have a permit/ licence in their quarry, while the same percentage 42.9 % of quarry managers with 26 % of general employee says no they have no a permit/ licence in their quarry. A large number of the respondents refused to say if they have a permit/ licence in their quarry. This finding supported the result of the fieldwork observations which stated that about half of the quarry sites work with an expired permit/ licence or without it.

Q1: Do you have a permit/ licence to operate this quarry?		Job details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
yes		6	3	3	1	13
		42.9%	75.0%	100.0%	6.7%	36.1%
no		6	0	0	4	10
		42.9%	.0%	.0%	26.7%	27.8%
I do not know		2	1	0	10	13
		14.3%	25.0%	.0%	66.7%	36.1%
Total		14	4	3	15	36
		100.0%	100.0%	100.0%	100.0%	100.0 %

Table 7.4 : Quarry Staff Answers to Question One

The respondents who said no, were asked if the used to have licence before as can be see from Table 7.5 that 80% said yes which means that the majority if the quarry working without licence they used to have licence before and they did not renew it; some of the respondents emphasised this could be due to good relation with family and tribe in the government organisations' allowed them to work without a licence.

Q2: If no to question1 did you have permit/ licence before		Job details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
yes		4	0	0	4	8
		66.7%	.0%	.0%	100.0%	80.0%
no		1	0	0	0	1
		16.7%	.0%	.0%	.0%	10.0%
I do not know		1	0	0	0	1
		16.7%	.0%	.0%	.0%	10.0%
Total		6	0	0	4	10
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.5 : Quarry Staff Answers to Question Two

In order to understand why some of the quarry owners stop renewing their licence; in question 3 the respondents have been given two reasons and asked to state which of those two made them to stop renewing their licence. The majority of them said large number of quarries working without licence and the local authority do not force them to have licence that is why we stopped renewing our licence. Additionally some of the quarry managers stated that there is a lack in the licence procedure which allows some of the quarry owners to stop renewing their quarry licence.

7.5.3.2 The Duration of the Licence

The respondents who say they have a licence were asked to state the duration of their licence. As can be seen from the Table 7.6 the vast majority of the respondents who said yes stated their licence was for between 1 to 10 years. Only one respondent stated the licence over 10 years which was an international company.

Q4: If yes to question 1 state the duration of permit/licence		Frequency	Percent
Valid	less than1 year	2	5.5%
	1-5 years	6	16.7%
	6-10 years	4	11.1%
	more than 10 year	1	2.8%
Missing	system	23	63.9%
Total		36	100%

Table 7.6 : Quarry Staff Answers to Question four

7.5.3.3 Perception of the Authority That Issued the Licence

The respondents who say they have a licence were asked to state the authority that issued the licence. As can be seen from Table 7.7, the majority of the respondents mentioned that their licence was obtained from the county government, 66.7% of the quarry managers and the administrators; on the other hand 66.7% of the supervisors stated that their licence was obtained from the Ministry of industry.

The results of this question presents that there is conflict between the government organisations, because the licence can be obtained from different source. Additionally, people's social relationships (family and tribe) in the Libyan community have negative impact of obtaining of permission without completing all the necessary documents. Clearly these factors will be significant in the investigation of any barriers that may exist to diminish environmental performance in the aggregates industry.

Q5: Which authority issued the permit/licence?		Job Details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
Local authority		1	0	0	1	2
		16.7%	.0%	.0%	100.0%	15.4%
County Government		4	1	2	0	7
		66.7%	33.3%	66.7%	.0%	53.8%
Ministry of Industry		1	2	0	0	3
		16.7%	66.7%	.0%	.0%	23.1%
Other		0	0	1	0	1
		.0%	.0%	33.3%	.0%	7.7%
Total		6	3	3	1	13
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.7 : Quarry Staff Answers to Question Five

From the last 5 questions, the permission to open a new quarry are usually granted with little or no consideration to other organisations requirements such as EIA report, agriculture permission etc... Also, when the decision is made those things are hardly given any weight which makes the granting procedure very ineffective in ensuring good environmental performance.

7.5.4 The Environmental Impact (Questions 6-19)

This section seeks to examine the quarry staff in terms of environmental protection, the environmental programmes in their quarry and its environmental impact on neighbouring residents or land owners. The opinion of the quarry staff about environmental protection provides some valuable information to this research.

7.5.4.1 Quarry Staff Awareness of Environmental Protection

Respondents were asked whether they are aware of the importance of environmental protection or not. As seen in Table 7.8, about 57.1 % of quarry manager, 50 % of supervisor and 100 % of administrator did say yes, while 42.9% of quarry managers, 50% of supervisors and all general employees said no.

Q6: Are you aware of the importance of the environmental protection?		Job details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
yes		8	2	3	0	13
		57.1%	50.0%	100.0%	.0%	36.1%
no		6	2	0	15	23
		42.9%	50.0%	.0%	100.0%	63.9%
Total		14	4	3	15	36
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.8 : Quarry Staff Answers to Question Six

The respondents who said no to question 6 were asked about the reasons for misunderstanding the importance of environmental protection; the respondents were given three reasons and asked to state which of these reasons is the mean reason for their misunderstanding; the majority of them said that, there is no environmental department in their quarry and the lack of communication between them and their supervisors and managers in environmental matters is the main reason of this misunderstanding. Also some respondents stated that the local authority and environmental institutions gave no opportunity to the quarry staff to attend courses or workshops to improve their skills in the field of environmental protection.

The respondents who said yes to question 6 were given some suggestion and asked to state from where they obtained their knowledge about environmental protection. Some of the quarry managers said they attend some seminar organized by the university and all the supervisors said they obtained knowledge from media such as satellite channels.

7.5.4.2 Assigned Personnel Responsible for Environmental Protection

The respondents were asked whether they have assigned personnel responsible for environmental protection in their quarry. As can be seen from Table 7.9 all respondents said no, which supported the answer in the last question; which means that there are no environmental departments in the quarry visited and environmental protection was not given any priority in those quarries

Q9: Is there assigned personnel in your company responsible for environmental protection?		Job details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
yes		0	0	0	0	0
		.0%	.0%	.0%	.0%	.0%
no		14	4	3	15	36
		100.0%	100.0%	100.0%	100.0%	100.0 %
Total		14	4	3	15	36
		100.0%	100.0%	100.0%	100.0%	100.0 %

Table 7.9 : Quarry Staff Answers to Question Nine

7.5.4.3 The Importance of the Environmental Protection Measures

Respondents were also asked if they felt that environmental protection measures are important. Table 7.10 shows that 57.1% of quarry managers, 50% of supervisors and 100% of the administrators said yes and only a small number of the respondents said no but 73.3% of general employees said they do not know or refused to answer.

Q11: Do you feel that environmental protection measures are important?		Job details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
yes		8	2	3	0	13
		57.1%	50.0%	100.0%	.0%	36.1%
no		0	1	0	4	5
		.0%	25.0%	.0%	26.7%	13.9%
I do not know		6	1	0	11	18
		42.9%	25.0%	.0%	73.3%	50.0%
Total		14	4	3	15	36
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.10 : Quarry Staff Answers to Question Eleven

The respondents were asked if there is any system introduced in their quarry which allowed them to make reports on the environmental impact. As can be seen from Table 7.11 all respondents said no; which means that the environmental matters are not important in the quarry visited.

Q12: Is there any system introduced by which you can make reports on your environmental impact		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	36	100.0	100.0	100.0

Table 7.11 : Quarry Staff Answers to Question Twelve

The respondents were asked if there is any environmental protection training for the employees that has taken place in the past year. As can be seen from Table 7.12 all respondents said no; also this question has proved that the environmental matters are not important in the quarry visited.

Q13: Is there any environmental protection training for the employees that has been taken place in the past year		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	36	100.0	100.0	100.0

Table 7.12 : Quarry Staff Answers to Question Thirteen

Most of the respondents indicated that they believed that environmental protection was important but their answers to Questions 12 and 13 of the questionnaire show that there is dissatisfaction about the lack of a system in the aggregate industry, through which employees could make their own feelings about environmental impact known. Also there is no training for the quarry staff to improve there skills in the field of environmental protection.

7.5.4.4 The Quarry Operation and Its Affect on the Environment

Respondents were asked specific questions to indicate whether the operation of their quarry affected the environment. The results of the survey to question 14 showed, in Table 7.13, that more than half of the respondents said they have environmental impact in their quarries. The findings from this question are significant because they show that the aggregate extraction creates environmental impacts.

Q14: Do you think the operation of your quarry has a detrimental effect on the quality of the environment?		Job details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
yes		9	3	3	4	19
		64.3%	75.0%	100.0%	26.7%	52.8%
no		1	0	0	4	5
		7.1%	.0%	.0%	26.7%	13.9%
I do not know		4	1	0	7	12
		28.6%	25.0%	.0%	46.7%	33.3%
Total		14	4	3	15	36
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.13 : Quarry Staff Answers to Question Fourteen

The respondents who said yes to the last question were asked to state the main reasons of the current environmental impacts, the respondents stated the following:

1. The machines and equipment used in the aggregates industry are not in good condition;

2. The quarry sites are placed near major cities and towns to meet the local demand and to decrease transportation cost;
3. The primary aggregates are the only source of aggregates produced by the aggregates industry in Libya.

Respondents who said yes were asked to state if they attempted to take any measures to reduce the impact. As can be seen from the answer to question 16 in the Table 7.14, 77.8% of the quarry managers said nothing has been done to reduce the impacts in their quarries; 66.7% of the supervisors stated that there was no system or measurement that has been used to reduce the impacts, and 75% of general employees pointed out that no environmental regulations in the quarrying industry were implemented to reduce the impact. Only 33.3% of administrators said that there were no measures used to reduce the environmental impact.

Q16: Have you attempted to take any measures to reduce the impact?		Job details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
yes		1	1	1	1	4
		11.1%	33.3%	33.3%	25.0%	21.1%
no		7	2	1	3	13
		77.8%	66.7%	33.3%	75.0%	68.4%
I do not know		1	0	1	0	2
		11.1%	.0%	33.3%	.0%	10.5%
Total		9	3	3	4	19
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.14 : Quarry Staff Answers to Question Sixteen

The respondents who said yes to question 16 were asked to state which measures they took to reduce the environmental impact in their quarry. The respondents stated the following:

1. Using water to reduce the dust emission;

2. Reduce the work to limited times e.g. start at 7.00 am and finish at 18.00 pm;
3. Avoid using blasting were possible.

This finding suggests that quarry staff know that their quarries affect the environment and that they do not attempt to reduce those impacts, which indicates that the environmental laws and regulations are not implemented or are ignored and the role of the government organisations is vague.

As the statistical data shows in Table 7.15, over half of the respondents stated that they get complaints from neighbouring residents or land owners, this supports the finding in the last three questions.

Q18: Do you get any complaints from neighbouring residents or land owners?		Job details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
yes		10	3	3	8	24
		71.4%	75.0%	100.0%	53.3%	66.7%
no		3	1	0	1	5
		21.4%	25.0%	.0%	6.7%	13.9%
I do not know		1	0	0	6	7
		7.1%	.0%	.0%	40.0%	19.4%
Total		14	4	3	15	36
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.15 : Quarry Staff Answers to Question Eighteen

The respondents who said yes to the last question were asked to state the main concern of these complaints, which were as follows:

1. The impact from dust, noise, blasting etc…;
2. The impact on landscape by leaving the quarry open after the work finished;
3. Impact to ground water from oil and fuel spills;

4. Impact to ground water from sea water intrusion. When extracting the aggregates below the sea water level the saltwater moves into the aquifer so that wells drilled on upland areas cannot obtain freshwater suitable for public consumption.

7.5.5 Environmental Laws and Regulations (Questions 20-24)

The objectives of this section are to assess the implementation of the environmental laws and regulations in the aggregate industry and if quarry staff abide to these laws and regulations. It is also designed to see how satisfied the quarry staff are with the current effort of the government in environmental protection.

7.5.5.1 Quarry Staff Awareness of the Environmental Laws and Regulations

Respondents were asked to indicate whether they are aware or have knowledge of environmental laws and regulations. The survey results, Table 7.16, show that more than 60 % of the quarry respondents said no and about 40 % said yes. The finding of this question proved that the environmental laws and regulations are not implemented and not of major concern in the aggregates industry. Clearly this factor will be significant in the investigation of any barriers that may exist to diminish implementation of the environmental laws and regulations in the aggregate industry. In order to qualify this finding the next series of questions dealt in more detail with respondents' view in the implementation of the environmental laws and regulations in the aggregate industry.

Q20: Are you aware of the importance of the Environmental Laws and Regulations?		Job details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
yes		8	2	2	2	14
		57.1%	50.0%	66.7%	13.3%	38.9%
no		6	2	1	13	22
		42.9%	50.0%	33.3%	86.7%	61.1%
Total		14	4	3	15	36
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.16 : Quarry Staff Answers to Question Twenty

Question 21 asked those who said yes to the last question if they abide by the enacted Laws and stated policies 64.3% of the respondents said yes and 35.7% said no. From the Table 7.17 it can be seen that even the respondents who are aware of the importance of the environmental laws and regulations did not always follow these laws and regulations which is means that the aggregate industry is not forced by the government organisations to follow stated environmental laws and regulations.

Q 21: Do you abide to the enacted Laws and stated policies		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	9	25.0	64.3%	64.3
	no	5	13.9	35.7%	100.0
	Total	14	38.9	100.0%	

Table 7.17 : Quarry Staff Answers to Question Twenty One

It is clear from Table 7.18 findings that the vast majority of respondents are not aware of the current environmental law and policies in relation to quarrying activity, with only 30.6% of the respondents said yes they are aware. This finding further shows that the environmental laws and policies in relation to quarrying activity are not known to large number of the aggregate industry employees and not of major concern to them. That is to some extent because the government organisations did not supply the aggregate industry with the stated environmental laws and regulations that apply to them and did not help the Industry to implement those laws and regulations and follow them.

Q22: Are you aware of the current environmental laws and policies in relation to quarrying activity		Job details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
yes		5	1	0	5	11
		35.7%	25.0%	.0%	33.3%	30.6%
no		9	3	3	10	25
		64.3%	75.0%	100.0%	66.7%	69.4%
Total		14	4	3	15	36
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.18 : Quarry Staff Answers to Question Twenty Twenty

Respondents were asked to indicate whether they have environmental management systems (EMS) in their quarry. As the previous findings show the majority of the quarries visited have no environmental plans and the environmental laws and regulations are not implemented. From the previous findings it would be reasonable to expect that the environmental management system (EMS) will not be in place as the answer of the question 23 shows (Table 7.19). This result leads the author to ask why not?

Q23: Does your company have any stated environmental management policy, objective and procedure		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	36	100.0	100.0	100.0

Table 7.19 : Quarry Staff Answers to Question Twenty Three

The respondents were asked in question 24, about the reason why they did not implement EMS in there quarry. Their answers are summarized as follows:

1. High implementation cost;
2. Lack of government pressure or support;
3. Lack of expressed interest or training to staff.

The results of the last two questions indicate that government needs to provide financial support for environmental laws, regulations and EMS implementation. The author also found out that the quarry staff never participated in any training or programmes concerning EMS or environmental protection in general, which could be the major obstacle hampering the environmental laws, regulations and EMS implementation.

The previous findings indicated that there is lack of communication between the aggregates industry and the government organisations. Some of the respondents emphasised this lack of communication in environmental protection matters was in some extent due to people's social relation such as family and tribe. These relations forced some of the government organisations to stop visiting the aggregates companies for work inspections or to force these companies to follow the environmental laws and regulations.

7.5.6 The Role of the Local Authorities (Questions 25-31)

In this section the author aimed to review the respondents' opinion about the local authority role in environmental protection in the aggregate industry in terms of quarry permission and rehabilitation and the implementation of environmental laws and regulations.

7.5.6.1 The Quarry Staff Opinion about the Local Authority

In this section the quarry staff were asked to state if an environmental protection plan was one of the requirements which the local authority needs to see before granting the work permission. As Table 7.20 shows, the vast majority of the respondents indicated that they did not submit any environmental protection plan about their quarry to the local authority, almost 79% of the respondents said no, whereas only 22% said yes. The finding of this question clearly indicates that the local authority role in the environmental protection is unsatisfactory and the next series of question are going to prove this finding

Q25: Does your local authority require you to produce environmental protection plan to your project before granting you permission?		Job details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
yes		3	1	0	4	8
		21.4%	25.0%	.0%	26.7%	22.2%
no		11	3	3	11	28
		78.6%	75.0%	100.0%	73.3%	77.8%
Total		14	4	3	15	36
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.20 : Quarry Staff Answers to Question Twenty Five

The respondents who said yes to the last question were asked to state what they have produced to their local authority to obtain permission; the vast majority of the respondents said they only provided two letters. The first from the Environmental General Authority, this is called environmental permission. This letter states that the place is meeting the environmental laws and regulations requirement. The second from the Ministry of Agriculture, this is called agriculture permission. This letter stated that the place is industrial land and not suitable for farming. However the planning systems require an EIA report and site rehabilitation plan with those two letters before granting the permission, which means the local authorities do not play their role as stated by the environmental laws and the regulations.

In question 27 the quarry staff where asked to indicate if they are required by the local authority to provide the end-use plan for their quarry. As stated in Table 7.21 all the respondents said no and this finding supported the finding in the last two questions, which is that the local authority do not follow the environmental laws and the regulations and its role in the environmental protection is deficient.

Q27: Does your local authority require you to produce the development proposal that includes the end-use of the quarry site		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	36	100.0	100.0	100.0

Table 7.21 : Quarry Staff Answers to Question Twenty seven

Respondents were asked whether they receive a copy of the current environmental legislation that applies to quarrying from the local authority. Results in Table 7.22 show that two-thirds of the sample answered no and 11.1% responded positively. Results also reveal that a large number of the respondents who said no came from small sized quarries and the reasons is that the local authority do not look after those quarries as a result, those quarries does not follow the environmental legislation and this led to a lot of environmental impacts.

Q28: Does your local authority provide you with the current environmental legislation that applies to quarrying		Job details				Total
		Quarry Manager	Supervisor	Administrator	General Employee	
yes		1	1	0	2	4
		7.1%	25.0%	.0%	13.3%	11.1%
no		10	2	2	8	22
		71.4%	50.0%	66.7%	53.3%	61.1%
I do not know		3	1	1	5	10
		21.5%	25.0%	33.3%	33.4%	37.8%
Total		14	4	3	15	36
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.22 : Quarry Staff Answers to Question Twenty Eight

As stated in the Libyan Regulatory Regime Paragraph 2.12.1 the government organisations must send inspectors to check the work in the quarry sites. Respondents were asked in question 29 whether they receive regular visits from the local authority for work inspection. All the respondents said no and this finding supported the finding in last three questions which is that the local authorities do not do their work as stated in the environmental laws and regulations.

In question 31 the quarry staff were asked to state what the local authority can do to improve its roles and responsibilities. The respondents stated that their local authorities must do all of these suggestions to improve its role in the planning system:

1. Preparing a technical staff to monitor the quarrying activity;
2. Help the quarry staff to improve their knowledge of environmental protection by providing them with training courses, seminars etc…;
3. improve its relations with other government institutions in the field of environmental protection;
4. Help the aggregate industry to implement the environmental laws and regulations by providing a budget for this.

7.5.7 The Role of Environmental Institutions (Questions from 32-35)

In this section the author aimed to review the respondents' opinion about the role of environmental institutions in environmental protection in the aggregate industry in terms of environmental assistance, advice, site visits and offering of courses, seminars etc...in the field of the environmental protection.

7.5.7.1 Quarry Staff Opinions about the Environmental Institutions' Role

The respondents were asked if they receive any kind of assistance or advice from the environmental institutions as regards environmental protection measures. All the respondents said "no, they did not offer us any help or advice". The finding of this question is that the environmental institutions did not play their role as stated in the environmental laws and regulations.

As mentioned above the Paragraph 2.12.1 (chapter Two) the Libyan Regulatory Regime stated that the government organisations must send inspectors to check the work in the quarry sites. The respondents were asked whether they receive regular visits from environmental institutions for work inspection. All the respondents said no and this finding supported the finding in the last question, which means that the environmental institutions do not do their work as stated in the environmental laws and regulations.

As stated in the Paragraph 2.12 the environmental institutions must provide guidance notes, courses, seminars, leaflets and magazines to help to improve environmental protection awareness in the industry. In this regard the respondents were asked if the environmental institutions offer them courses, seminars, leaflets etc... in relation to environmental protection. All the respondents said no. the finding from this question is very important because it shows that the environmental institutions did not do one of its important roles and fulfil their responsibility as stated in their established law and acts.

7.6. The Government Organisations Employees' Interviews:

The second element of the sample is the government organisation employees who would be able to express their professional opinions and their points of view on the environmental impact of the aggregate industry. They are able to draw a clear picture of what the clients had raised in discussion with them over the years about their quarry operation, environmental impacts and the environmental laws and regulations. As was mentioned, 30 employees from the three case studies (Environmental General Authority, Industrial Research centre and local authority) were interviewed Table 7.23. Seven of them were female and 23 male; 10 of them have more than 20 years of experience. The rest had experience of 20 years or less. The aim of the survey was to obtain views of the professionals regarding the following:

1. Information about the operation permission;
2. Information about the environmental impact of industry;
3. government organisation employees awareness of the environmental laws and regulations in Libya in general;
4. The local authority role in the field of the environmental protection (The local authority employees only);
5. The environmental institutions' role in the field of the environmental protection (The environmental institutions employees only).

Organisation	Administrators	Inspectors	Department Managers	Senior Managers	Total
EGA	2	5	3	3	13
IRC	-	2	3	2	7
Local authorities	1	3	3	3	10

Table 7.23 : Showing the Number of the Respondents from Each Case Studies Organisations

7.6.1 Data Collection Methods

Data was collected through conducting semi-structured interviews within the government organisations employees with administrators, inspectors, department managers and senior managers based on both closed and open-ended questions. Social and personal relationships played an important role in supporting the formal request to collect the data from the government organisations.

As part of the general survey investigating the role of the government organisations in the planning permission, the three administrators, ten inspectors, nine department managers and eight senior managers were interviewed to ascertain their views and opinions on this topic, and to gain in-depth data. Initially, questions relating to the operation permission, environmental impacts and environmental laws and regulation were asked, simply to introduce the more general topic area before moving on to ask these employees for their opinion on role of their institution in the field of environmental protection.

The interviews, which were held between March and April 2006, ranged from forty-five minutes to one hour in duration. Some interviews were held with more than one participant at the same time. Notes were taken during interviews followed by a summary of the main points and issues raised in the interviews.

7.6.2 Data Analysis

Having described the data collected from the government organisations; this section describes how the interview data were analysed. The data collected were analysed using SPSS Software to explore the opinions and views of the respondents about the environmental protection and their understanding of the environmental laws and regulations and their institutions role in the field of environmental protection. Data from literature and official documents were used to support the analysis and provide more understanding of the government organisations role and its relationships with the aggregates industry.

7.6.3 The Operation Permission (Questions 1-10)

The starting point for the discussion during the semi-structured interviews was to understand whether or not the organisation of the respondents are included in the permit/ licence procedure for opening a new quarry, 23 out of thirty respondents stated yes as can be seen in Table 7.24. The respondents who said no are the IRC staff, because IRC is a technical organisation and not engaged in permit/ licence procedure.

Q1: Is your organisation included in the permit/ licence procedure of opening quarry		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	23	77	77	77
	no	7	23	23	100
Total		30	100	100	

Table 7.24 : Interviewees Answers to Question One

According to the fieldwork results (Chapter Six) the author has recorded a number of roles and responsibilities about the government organisations' role in the permit/ licence procedure of opening a quarry. In question 2, the author gives the respondents who said yes to the last question the obvious five roles and responsibilities and asks them to state what is their organisation's main role and responsibility. The respondents stated the following:

The EGA are responsible for:

- Issuing the environmental permission;
- Work inspectors to stop the quarry operation from generating environmental impacts.
- Study the EIA reports before granting the permission

The local authority is responsible for:

- Issuing the work permission;
- Implementing the laws and regulations and force people to follow them;
- Work inspectors to check that the quarry operation follows the stated laws and regulation.

The finding from questions one and two is that the local authorities are responsible for issuing the work permission for opening of a new quarry and have great power to minimize the environmental impacts and in maintaining sustainable development in the aggregate industry. But the local authorities grant work permission without considering other government organisations' requirements.

Respondents were asked if the budget allocated to their organisations was sufficient to meet the organisation goal in the planning system, as the results in Table 7.25 show, 75 % of senior manager, 66.7% of the department manager and 60% of the inspector said their organisations budget is not enough to meet the organisation goal. This means that the majority of the government organisations staff was dissatisfied with their organisation budget.

Q3: Is the budget, allocated to your organisation sufficient to meet your organisation goal in the planning system		Job details				Total
		Administrator	Inspector	department manager	Senior manager	
yes		1	2	2	0	5
		33.3%	20.0%	22.2%	.0%	16.7%
no		1	6	6	6	19
		33.3%	60.0%	66.7%	75.0%	63.3%
I do not know		1	2	1	2	6
		33.3%	20.0%	11.1%	25.0%	20.0%
Total		3	10	9	8	30
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.25 : Interviewees Answers to Question Three

7.6.3.1 The Current Licence Procedure for Opening New Quarry

The current permit/ licence procedure for opening a new quarry in Libya has been described in the Paragraph 2.14 (Chapter two). Here the respondents were asked to express their thoughts about the current permit/ licence procedure for opening a new quarry. As seen in Table 7.26, the data from the survey showed that (24/30) respondents said the current permit/ licence procedure is not adequate, this means that the vast majority of the respondents are not happy with the current licence procedure.

Q4: Do you think that the current permit/ licence procedure adequate		Job details				Total
		Administrator	Inspector	department manager	Senior manager	
yes		1	1	1	3	6
		33.3%	10.0%	11.1%	37.5%	20.0%
no		2	9	8	5	24
		66.7%	90.0%	88.9%	62.5%	80.0%
Total		3	10	9	8	30
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.26 : Interviewees Answers to Question Four

In order to understand the reason for the respondents answer to the last question, the author gave the respondents who said no to the last question the obvious five reasons which had been recorded from the fieldwork observations and the questionnaire survey and asked them to state which of these reasons make the licence procedure inadequate. The respondents stated the following:

- There is no communication or sharing of ideas between the government organisations in terms of permission, experience, control of aggregate extraction and implementing of environmental laws and regulations. Some senior managers emphasised this lack of communication could be due to people's social relationships resulting from family and tribe;
- There is more than one organisation who granted working permission and that caused conflict between them and the planning system;
- There is no one responsible for monitoring the permission and to force the aggregate company to renew their permission;
- Limitation of funding in some of the organisations which caused the absence of its role and responsibilities as stated by the environmental laws and regulations;
- The local authorities did not help the EGA and IRC to do their work properly;

- Some of the government organisations' employees did not follow the procedure for opening a new quarry due to people's social relationships resulting from family and tribe in the Libyan communities.

The respondents proved that the reasons which have been picked up by the author in the fieldwork observations and the questionnaire survey are correct. The finding in the last question stated that the vast majority of the respondents were not happy about the current licences procedure, in this respect the respondents were given some suggestions and asked to state if they think these suggestions will improve the current permit/ licence procedure for opening a new quarry. The respondents accepted all of the suggestions which are as follows:

- The investor must submit an acceptable environmental impact assessment (EIA) report to any new quarry before getting the permission;
- All the government organisations must have highly qualified staff to monitor the aggregate industry and to run work inspection;
- The government must introduce a system which can be used to link all government organisations to stop misfeasance of granting permission;
- The local authorities must ask the investor to provide money as guarantee for site restoration;
- The permission must have limited time;
- The government must provide sufficient budget to the organisations to do the work properly.

Additionally, all of the respondents who said no to Question Four supported the idea that the current licence procedure would require a budget to set up the necessary programmes to improve it. The senior managers considered an evaluation of current licence procedure as the first important step toward the introduction of proper licence procedure, which they felt should initially be targeted at the most obvious areas of concern.

7.6.3.2 Why Quarries Work with Expired Permission or Without Permission

As previously said in Paragraph 6.3.2.1 (Chapter Six) there are high numbers of quarries operating with expired, or without, permission and the respondents were asked if they are aware of that. As can be seen from Table 7.27 that (28/30) of the respondent stated yes they are aware of that. The Table shows that (100%) of the department managers and senior manager said yes also (90%) of the inspectors and (66.7%) of the administrator said yes which means that the government organisations knows the problem and they did nothing to solve it.

Q7: Are you aware that there are large numbers of quarry operating with expired or simply without permit/ licence		Job details				Total
		Administrator	Inspector	department manager	Senior manager	
yes		2	9	9	8	28
		66.7%	90.0%	100.0%	100.0%	93.3%
I do not know		1	1	0	0	2
		33.3%	10.0%	.0%	.0%	6.7%
Total		3	10	9	8	30
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.27 : Interviewees Answers to Question Seven

According to the fieldwork results (chapter six) the author has recorded a number of reasons about why those quarries are working with expired or without permission. The author gave the respondents who said yes to the last question the obvious five reasons and asks them to rank those reasons in order, starting with the most important one.

The vast majority of the respondents rank them as follows:

1. Lack or poor implementation of laws and regulations;
2. Lack/Absence of local authority role;
3. Lack/Absence of the environmental institution role (EGA, IRC);
4. Lack of qualified staff in the County (Al-Shabiat) government;
5. Lack of experts in the Ministry (Popular committee) of Industry.

Additionally respondents were asked to indicate whether their organisations have any authority to stop, control and monitor operations. The results showed, Table 7.28, that twenty one out of thirty respondents said yes and eight out of thirty said no. The respondents who said no seven of them are the IRC staff, because IRC is a technical organisation and not engaged in operation monitoring.

Q9: Does your organisation have any authority to stop, control and monitor operations		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
yes		2	8	6	5	21
		66.7%	80.0%	66.7%	62.5%	70.0%
no		0	2	3	3	8
		.0%	20.0%	33.3%	37.5%	26.7%
I do not know		1	0	0	0	1
		33.3%	.0%	.0%	.0%	3.3%
Total		2	8	6	5	21
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.28 : Interviewees Answers to Question Nine

In order to understand the main responsibility of each organisation. Question number 10 gave the respondents (EGA and local authorities' staff) who said yes to last question numbers of factors and asked them to state what their organisation can do from these factors to stop, control and monitor operations. The respondents stated the following:

The EGA could:

- Do not give an environmental permission to any quarry works without permission.

The local authority could:

- produce a resolution to close any quarry making environmental impact
- Implementing the laws and regulations and force people to follow them;
- Non-renewal of the ended licences

These findings indicate that the government organisations employees do not know all of their organisations roles and responsibilities by which they can stop, control and monitor operations.

7.6.4 The Environmental Impacts (Questions 11-16)

Question 11 asked the respondents if they are aware of the importance of environmental protection. It can be seen from Table 7.29, all of the respondents are aware of the importance of the environmental protection which means that the organisations are aware too.

Q11: Are you and your organisation aware of the importance of environmental protection		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	30	100.0	100.0	100.0

Table 7.29 : Interviewees Answers to Question Eleven

The respondents were asked to state what is their organisation's main role in the environmental protection. The respondent's answers have been characterised as follows:

The EGA staff stated that their organisations main roles are:

1. Spreading the environmental awareness in the society by the media;

2. Visiting the affected places and try to improve its environmental condition;
3. Produce annual reports about the projects making environmental impact.

The Local authorities' staff stated that their organisation's main role is:

1. Implementing the environmental laws and regulations by forcing the industry to follow them, also making sure that the society is aware of them its importance;
2. Penalises any project making environmental impact, this could be done by paying money to solve these environmental problems or by cancelling their working permission.

The IRC staff stated that their organisation's main role is:

1. Control of pollution particularly of industrial origin such as oil and fuel spills;
2. Control of products such as aggregates products and making sure that the product in high quality and matches the typical specification.

The planning system and the General Peoples Committee have given the local authorities and the EGA comprehensive roles and responsibilities covering all source of development such as the aggregate industry and its environmental issues. But from what the staff stated it's clearly that these two organisations did not play all of their roles and responsibilities as required by the planning system. Large numbers of respondents stated that there was no system of joint consultation for environmental protection between the aggregate industry and government organisations to discuss an environmental protection matter; that is to some extent due to the absence of an environmental department in the aggregates industry and lack of interest from the government organisations. In addition the government organisations did not offer any courses or training to the aggregates industry in relation to environmental protection due to lack of experts and absence of master plan for environmental protection training and development in the country. These findings indicate a lack of communication between the aggregate industry and the government organisations even in such an important area as environmental protection.

In question 13, the respondents were asked if they are agreed or disagreed with some of the provided reasons for the current environmental impacts of the aggregate industry see Table 7.30. The purpose of these questions was also to find out that if the respondents are aware of those impacts or if there is research done in their organisation concerning this matter.

Reasons	SD	D	UD	A	SA
The primary aggregates is the only source of aggregates used by the industry	1	3	4	16	6
	3.3%	10 %	13.3%	53.3%	20%
The organisations monitoring and controlling the quarrying industry are incapable to stop its environmental impacts	2	3	6	13	6
	6.7%	10 %	20%	43.3%	20%
The offices responsible for implementing the environmental laws and regulations did not do their job	0	2	4	15	9
	0%	6.7 %	13.3%	50%	30%
Placing the quarry near the populated areas to meet the local demand	0	2	1	18	9
	0%	6.7 %	3.3%	60%	30%
Bad conditions of machines and equipments used to produce the aggregate	0	2	1	18	9
	0%	6.7 %	3.3%	60%	30%
most of the quarry making environmental impacts belong to micro or family company which has financial difficulty to implement the environmental laws and regulations	0	2	4	15	9
	0%	6.7 %	13.3%	50%	30%
The Libyan government did not give loans or help to produce an alternative aggregates products	0	0	0	16	14
	0%	0%	0%	53%	46.7%

Table 7.30 : Interviewees Answers to Question Thirteen

As Table 7.31 shows the Researcher in question 14 asked the respondents if they think the following suggestions can improve or help to improve the environmental impact from the aggregate industry.

Reasons	SD	D	UD	A	SA
There must be an environmental impact assessment report to any new quarry	1	3	4	16	6
	3.3%	10 %	13.3%	53.3%	20%
The permission procedure system must follow the environmental laws and regulations also the guidance notes provided by the EGA	0	0	0	16	14
	0%	0%	0%	53%	46.7%
The quarry land must be industrial land and agreed by the Ministry of Industry	2	2	7	11	8
	6.7%	6.7 %	23.3%	36.6%	26.7%
The government must encourage companies to use the secondary aggregates and help them to produce more alternative products	0	2	1	9	18
	0%	6.7 %	3.3%	30%	60%
The equipment used to produce aggregates must be compatible with the environmental standards	0	2	2	10	16
	0%	6.7 %	6.7%	33.3%	53.3%

Table 7.31 : Interviewees Answers to Question fourteen

From the two Tables 7.30 and 7.31 large numbers of the respondents are agreed with the reasons and suggestions which have been picked up from the fieldwork observations.

7.6.4.1 Complaints about the Environmental Impacts

Respondents were asked in question 15, if they get any complaints from the neighbouring residence or land owners. Twenty three out of thirty respondents said yes and those are the environmental general authority and the local authority employees; the industrial research centre employees said no, the reason for saying no is that the IRC is a technical organisation and its environmental role is limited.

The respondents who said yes were given a list of impacts and asked to state if the complaints were about those impacts, the respondents stated the following:

- Impact of noise and dust;
- Visual impacts such as destruction of vegetation and wildlife;
- Impacts to human health;
- Impacts from blasting;
- Impact to ground and surface water such as sea water intrusion to the ground water.

According to some complaints papers, which the researcher collected during his field study most people were complaining about the closeness of the quarry sites to the residential areas and the impact of these quarries to ground water. The researcher asked some of the respondents about what the government organisations did with these complaints; the vast majority said nothing has been done so far.

7.6.5 The Environmental Laws and Regulations (Questions 17-22)

In question 17 the government organisations staff were asked if they are aware of the importance of the environmental laws and regulations. It can be seen from Table 7.32 that all of the respondents are aware of the importance of the environmental laws and regulations.

Q17: Is your organisation aware of the importance of the environmental laws and regulations		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	30	100.0	100.0	100.0

Table 7.32 : Interviewees Answers to Question Seventeen

The respondents who said yes to the last question were asked to state if they follow the environmental laws and regulations. Table 7.33 shows that 67.7% of the respondents said no which means the government staff does not follow the stated environmental laws and regulations even though they know its importance.

Q18: Do you follow the environmental Laws and Regulations		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
yes		0	4	3	1	8
		.0%	40.0%	33.3%	12.5%	26.7%
no		2	6	5	7	20
		66.7%	60.0%	55.6%	87.5%	66.7%
I do not know		1	0	1	0	2
		33.3%	.0%	11.1%	.0%	6.7%
Total		3	10	9	8	30
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.33 : Interviewees Answers to Question Eighteen

In question 19, the respondents were asked to state if their organisations are involved in the implementation of the environmental laws and regulations. Twenty three out of thirty respondents said yes and those are the environmental general authority and the local authorities' employees; the industrial research centre employees said no, the reason for saying no is that the IRC is a technical organisation and not involved in the implementation of the environmental laws and regulations.

The main role of the EGA is producing the guidance notes and providing the new projects with the environmental laws and regulations that apply to them. The main role of local Authorities is to ensure that the laws and regulations are fully implemented and cover all source of development. But some of the respondents stated that the environmental laws and regulations are not implemented and also their organisation' roles are absent, and that is could be due to lack of budget and lack of communication between government organisations.

In response to the question 19, when the respondents were asked what are the main obstacles facing the implementation of the environmental laws and regulations in the Libyan Aggregate Industry, the respondents stated the following:

1. Disregard from the relevant department to implement the laws and regulations;
2. Conflict between the organisations in granting permission;
3. Disregard of the EGA role from other government organisations;
4. Shortage of qualified staff to implement the laws and regulations;
5. Financial difficulty in some of the aggregate companies.

7.6.5.1 Government Staff Awareness of the Laws and Regulations Applying To the Aggregates Industry

Question 21 asked the respondent if they are aware of current environmental laws and regulations that apply to quarrying. As can be seen from Table 7.34 twenty out of thirty respondents said yes which means that the vast majority of the government organisations staff are aware of the environmental laws and regulations. Additionally the researcher asked some of the respondents if they are aware of the importance of the EMS, a large number stated they are not aware of it and their organisations did not offer them any courses or training about it.

Q21: Are you aware of current environmental Laws and Regulations that applies to quarrying		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
yes		2	6	5	7	20
		66.7%	60.0%	55.6%	87.5%	66.7%
no		0	4	3	1	8
		.0%	40.0%	33.3%	12.5%	26.7%
I do not know		1	0	1	0	2
		33.3%	.0%	11.1%	.0%	6.7%
Total		3	10	9	8	30
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.34 : Interviewees Answers to Question Twenty One

Respondents were asked in the next question (Question 22) if they assist the quarry owners with the latest environmental Laws and Regulations which applies to them. As can be seen from the results shown in Table 7.35 60% of the respondents said no, which means that the government organisations do not assist the aggregate industry with the latest environmental laws and regulations.

Q22: Do you assist the quarry owners with the latest environmental Laws and Regulations which applies to them		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
Yes		0	2	2	2	6
		.0%	20.0%	22.2%	25.0%	20.0%
No		2	6	5	5	18
		66.7%	60.0%	55.6%	62.5%	60.0%
I do not know		1	2	2	1	6
		33.3%	20.0%	22.2%	12.5%	20.0%
Total		3	10	9	8	30
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.35 : Interviewees Answers to Question Twenty Two

7.6.6 The Local Authorities Role in the Planning System (Questions 23-32)

Question 23 was designed to assess whether local authority staff know that the local authority has the statutory powers pertaining to planning, development and management of environmental protection. The results from the respondents' answers to this question indicate that there is very high understanding of the local authority powers from the staff. See Table 7.36.

Q23: Do you know that the local authority has the statutory powers pertaining to planning, development and management of environmental protection		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
yes		1	3	2	2	8
		100.0%	100.0%	66.7%	66.7%	80.0%
no		0	0	0	1	1
		.0%	.0%	.0%	33.3%	10.0%
I do not know		0	0	1	0	1
		.0%	.0%	33.3%	.0%	10.0%
Total		1	3	3	3	10
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.36 : Interviewees Answers to Question Twenty Three

The respondents in question 24 were asked if the local authority has any power to control and monitor quarrying impact. As can be seen from Table 7.37 the majority of the respondents stated yes, which supported the finding in the last questions.

Q24: Is the local authority has power to control and monitor quarrying impact		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
yes		0	3	2	3	8
		.0%	100.0%	66.7%	100.0%	80.0%
no		1	0	0	0	1
		100.0%	.0%	.0%	.0%	10.0%
I do not know		0	0	1	0	1
		.0%	.0%	33.3%	.0%	10.0%
Total		1	3	3	3	10
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.37 : Interviewees Answers to Question Twenty Four

The respondents who said yes to the last question were asked what the local authority can do to control and monitor quarrying impacts. The respondents stated the following:

1. The local authorities must stop granting permission;
2. The local authorities must make sure that the finished sites are fully restored as planned by the relevant departments;
3. The local authorities must close any site making environmental impacts;
4. The local authorities must close any quarry working without permission.

In the response to question 26, which asked the respondents if they are agree with the current role of the local authorities, seven out of ten stated they disagree Table 7.38,

In question 27, 28, 29 and 30 the author asked the respondents direct questions related to the local authorities' role in the planning systems.

Q26: Based on your experience and knowledge do you agree with the current role of the local authority		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
Agree		0	0	2	0	2
		.0%	.0%	66.7%	.0%	20.0%
Disagree		1	3	0	3	7
		100.0%	100.0%	.0%	100.0%	70.0%
I do not know		0	0	1	0	1
		.0%	.0%	33.3%	.0%	10.0%
Total		1	3	3	3	10
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.38 : Interviewees Answers to Question Twenty Six

The first direct question was asked to the local authorities' staff to state if they ask the quarry owners to produce environmental protection plans before granting them permission. The interview data in Table 7.39 shows that seven out of ten respondents said no, this means that the local authorities do not follow the procedure for opening a new quarry which is specified by the planning system.

Q27: Do you ask the quarry owners to produce environmental protection plan before granting them permission		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
yes		0	0	1	0	1
		.0%	.0%	33.3%	.0%	10.0%
no		1	1	2	3	7
		100.0%	33.3%	66.7%	100.0%	70.0%
I do not know		0	2	0	0	2
		.0%	66.7%	.0%	.0%	20.0%
Total		1	3	3	3	10
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.39 : Interviewees Answers to Question Twenty Seven

The second direct question was to ask the local authority staff if they ask the quarry owners to produce the development proposal that includes the end-use of the quarry site before granting them permission. As can be seen from Table 7.40 the vast majority of the respondents said no, which proved that the local authorities' staff do not follow the stated procedure for opening a new quarry.

Q28: Do you ask the quarry owners to produce the development proposal that includes the end-use of the quarry site		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
yes		1	0	0	2	3
		100.0%	.0%	.0%	66.7%	30.0%
no		0	2	3	1	6
		.0%	66.7%	100.0%	33.3%	60.0%
I do not know		0	1	0	0	1
		.0%	33.3%	.0%	.0%	10.0%
Total		1	3	3	3	10
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.40 : Interviewees Answers to Question Twenty Eight

The third direct question was asked to the local authority staff to state if they supply the quarry owners with the current environmental Laws and Regulations that apply to quarrying. As can be seen from Table 7.41, 60% of all respondents said no, which proved that the environmental laws and regulations are not of major concern by the local authority staff and that is could be the reason for not implementing the environmental laws and regulations in the aggregate industry.

Q29: Do you supply the quarry owners with the current environmental Laws and Regulations that applies to quarrying		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
yes		1	1	0	2	4
		100.0%	33.3%	.0%	66.7%	40.0%
no		0	2	3	1	6
		.0%	66.7%	100.0%	33.3%	60.0%
I do not know		0	0	0	0	0
		.0%	.0%	.0%	.0%	.0%
Total		1	3	3	3	10
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.41 : Interviewees Answers to Question Twenty Nine

The fourth direct question was asked to the local authorities' staff to state if they regularly visit the quarry sites for work inspection. As can be seen from the results in Table 7.42, nine out of ten respondents said no, which proved that the local authority staff do not go for work inspection as required by the environmental laws and regulations.

Q30: Do you regularly visit the quarry sites for work inspection		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
yes		1	0	0	0	1
		100.0%	.0%	.0%	.0%	10.0%
no		0	3	3	3	9
		.0%	100.0%	100.0%	100.0%	90.0%
Total		1	3	3	3	10
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.42 : Interviewees Answers to Question Thirty.

The last question for local authority staff concentrated on views and opinions about how their organisation's role can be improved. The purpose of this question was also to find out if the local authority staff were aware of what their organisations need to do to improve its role in the field of the environmental protection. The Researcher in question 32 asked the respondents if they think the following suggestion can improve or help to improve the local authority role in the planning systems.

As Table 7.43 shows the respondents' answers mainly ranged between strongly agree, agree, and undecided; whilst none have indicated that they disagree or strongly disagree; which is mean that the respondents agree with these suggestions and they think it could improve the local authorities role.

Suggestions	SD	D	UD	A	SA
Stop granting permission to any quarry without completing all the necessary documents	0	0	1	6	3
	0%	0%	10%	60%	30%
The local authority must prepare specialised technical cadres to monitor the aggregate industry	0	0	2	6	2
	0%	0%	20%	60%	20%
The local authority must give more roles to the environmental institutions	0	0	2	6	2
	0%	0%	20%	60%	20%
Activate the environmental laws and the regulations and force the aggregate industry and the government organisations to follow them.	0	0	0	5	5
	0%	0%	0%	50%	50%
The local authority must make sure that the equipments used to produce aggregates compatible with the environmental standards	0	0	1	9	0
	0%	0%	10%	90%	0%

Table 7.43 : Interviewees Answers to Question Thirty Two.

7.6.7 The Environmental Institutions Role in the Planning Systems (Questions 33-42)

In order to examine the environmental institution's role in the planning system the author asked the environmental institutions' staff direct questions to gain a general knowledge about its role and responsibility.

In question 33 the respondents were asked if their organisation has any branch/office outside the headquarters. As can be seen form Table 7.44 thirteen out of twenty respondents said yes and seven out of twenty said no.

The respondents who said yes were the EGA staff and they mention that there is an office in every state (AL-Shabiat). The respondents who said no were the

IRC staff and they mention that there is only one office which is located in Tripoli (the capital).

Q33: Does your organisation have any branch/office outside the headquarters		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	13	65	65	65
	no	7	35	35	100
Total		20	100	100	

Table 7.44 : Interviewees Answers to Question Thirty Three.

Respondents who said yes to the last question were asked in question 34, if they think those offices will help their organisation to improve its role in the planning system. The vast majority of the respondents said yes and indicated that it will allow their organisation to control all sources of development.

The respondents who said no stated that their organisation has only one office and that affected its ability to control all sources of development such as aggregates production.

Respondents were asked to indicate if their organisations give any assistance or advice to the quarry owners in regards to the environmental protection. As can be seen from Table 7.45 55% of all respondents said no, which means that the environmental institution does not do its job as required by the planning systems.

Q36: Does your organisation give any assistance or advice to the quarry owner in regards to the environmental protection		Job details				Total
		Administrator	Inspector	Department Manager	Senior manager	
yes		1	1	1	0	3
		50.0%	14.3%	16.7%	.0%	15.0%
no		1	5	3	5	14
		50.0%	71.4%	50.0%	100.0%	70.0%
I do not know		0	1	2	0	3
		.0%	14.3%	33.3%	.0%	15.0%
Total		2	7	6	5	20
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.45 : Interviewees Answers to Question Thirty Six.

The author asked the respondents about the reasons why their organisation did not assist the quarry owners in regard to the environmental protection as stated by its established laws and acts. The respondents stated the following:

1. Large numbers of the quarry owners work without environmental permission;
2. The local authority did not help the environmental institutions to play its part in the environmental protection scheme;
3. The budget allocated to the environmental institutions is very little compared to its role and responsibility.

In question 38 the respondents were asked to state if they regularly visit the quarry sites for work inspection. As can be seen from the results shown in Table 7.46, 60% of the respondents said no, which proved that the environmental institutions staff do not go for work inspection as stated by the environmental laws and regulations.

Q38: Does your organisation regularly visit the quarry sites for work inspection		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
yes		1	2	1	1	5
		50.0%	28.6%	16.7%	20.0%	25.0%
no		0	5	4	3	12
		.0%	71.4%	66.7%	60.0%	60.0%
I do not know		1	0	1	1	3
		50.0%	.0%	16.7%	20.0%	15.0%
Total		2	7	6	5	20
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.46 : Interviewees Answers to Question Thirty Eight.

Respondents were asked in question 40 if their organisations has offered to the quarry owners any courses, seminars, leaflets etc... in relation to environmental protection. As can be seen in Table 7.47, 55% of the respondents said no, this finding supported the finding in the last two questions, which means that the environmental institutions did not help the quarry owners to improve the environmental condition in their sites.

Q40: Is your institution offered the quarry owners courses, seminars, leaflets etc... in relation to environmental protection		Job details				Total
		Administrator	Inspector	Department Manager	Senior Manager	
yes		1	1	1	2	5
		50.0%	14.3%	16.7%	40.0%	25.0%
no		0	4	4	3	11
		.0%	57.1%	66.7%	60.0%	55.0%
I do not know		1	2	1	0	4
		50.0%	28.6%	16.7%	.0%	20.0%
Total		2	7	6	5	20
		100.0%	100.0%	100.0%	100.0%	100.0%

Table 7.47 : Interviewees Answers to Question Forty.

The author gave the environmental organisations staff a number of difficulties in question 41, and asked them to state what difficulties are facing their organisations to do its ideal role according to the environmental law and regulations. The respondents stated the following:

1. Lack of cooperation from other government organisations;
2. Shortage of equipment and qualified staff to do the work;
3. Lack in some of the laws and conflicts of roles and responsibility between the government organisations;
4. Lack of application of the environmental laws and regulations and lack of local authority ability to force the aggregate industry and the government organisations to follow them;
5. Lack of understanding of the IRC role in the planning systems from all government organisations.

The last question (question 42) to environmental organisations' staff was to ask them to state their views and opinions about how their organisation's role can be improved. The purpose of this question was also to find out if the environmental organisation's staff know what their organisation needs to improve to play its part in the planning system. The Researcher in question 42 asked the respondents if they think the following suggestion can improve or help to improve the environmental organisation's roles in the planning systems.

As Table 7.48 shows, the respondents answers mainly ranged between strongly agree, agree, and undecided; whilst none have indicated that they disagree or strongly disagree.

Suggestions	SD	D	UD	A	SA
The environmental organisations must Ask for the environmental impact assessment report to any new project before granting permission	0 0%	0 0%	1 10%	6 60%	3 30%
The local authority must prepare specialised technical cadres to monitor the aggregate industry	0 0%	1 10%	3 30%	3 30%	3 30%
Use public media such as TV and newspapers to educate people of the importance of the environmental protection	0 0%	0 0%	2 20%	6 60%	2 20%
The environmental institutions must prepare courses and seminars to the aggregate industry and the government organisations staff	0 0%	0 0%	1 10%	5 50%	4 40%
The environmental institutions must ask for more money from the government to do its part comprehensively	0 0%	0 0%	1 10%	7 70%	2 20%

Table 7.48 : Interviewees Answers to Question Forty Two.

7.7. Chapter Summary

In this chapter, the researcher displayed the findings of this research, which have included a search of documentation in the government organisations and aggregates industry, the interviews with government organisations' employees, and the questionnaire exercise with quarry staff. The chosen case study strategy in this research provides valuable in-depth information about the environmental impacts from aggregates industry in Libya and the barriers affecting the implementation of the environmental laws and regulations. The present findings supported the need to study the overall situation regarding the environmental impacts from aggregate extraction and the reasons why the environmental impact is not a high priority.

A full discussion of the findings from this survey is presented in Chapter Eight.

CHAPTER EIGHT

Chapter Eight
Discussion of Findings

8.1. Introduction

This chapter analyses the findings and results that have emerged from the data presented in Chapters Six and Seven. It links the previous chapters together and links the literature with the empirical side of the research. It presents interpretation, triangulation and reflection of the quantitative and qualitative results presented in the previous two chapters; in addition, comparisons with other related studies are made.

From this research, it is clear that the environmental impacts of aggregate extraction are very serious in Libya and the environmental protection plan that attempts to control them is weak. The barriers facing the environmental protection plan's implementation can exist at individual, managerial, organisational, and national levels, and this chapter highlights those environmental impacts and the barriers which appear when the aggregate industry and government organisations ignore the need for environmental protection, or simply believes that for them, it is not essential. Of course even if the rationale for environmental protection is apparent to an organisation there may be a lack of funds, skills, determination, structure and culture to implement an environmental protection policy. Additionally, insufficient support from government for environmental protection and failure to involve employees in their own development through environmental protection programmes also creates problems. Barriers can also be created at government level through little or no investment in environmental protection and poor provision of resources, and these will be compounded if there is no serious commitment to high-skill strategies within the country, or insufficient pressure is placed on the environmental institutions to play their part in the environmental protection plan. In Libya, social and economic changes, the traditional influence of both tribe and family, and cultural influences can also have negative effects on environmental protection plan implementation, as their impact on organisational culture has an affect on communication processes.

As already indicated in Chapter Two, the Libyan aggregates industry is very huge ranging from large national or international companies operating throughout the country to smaller private companies based within Counties or local areas, those small quarries serving provincial towns and rural markets (Masoud et al. 1998). The Libyan aggregate industry has been developed very fast in the last decade as aggregate extraction has increased dramatically to meet demand especially near urban centres. This growth has created a lot of environmental impacts. In analysing these impacts, this chapter seeks in particular to address the following key points:

- Analysis of the questionnaires, interviews and the fieldwork findings.
- Discussion of the main findings
- Limitations of the research

8.1.1 Analysis of the Questionnaires, Interviews and the Fieldwork findings

The findings from the questionnaires, interviews and the fieldwork are compared and interfaced towards addressing the environmental impacts of the Libyan Aggregate Industry and to improve the government organisations' roles in the planning systems. This will be the foundation for improving of the Libyan regulatory regime to control the environmental impacts in the aggregates industry. The findings are grouped into six themes as in Table 8.1:

Table 8.1 The Main Findings of the Research

Main issues	Research findings		
	Quarry staff (Questionnaires)	Government organisations employees (Interviews)	Fieldwork evidence
The work permission	- Ten respondents said that a large number of quarries were working without permission. See Table 7.4	- Twenty eight respondents stated that there are high numbers of quarries operating with expired permission or without permission. See Table 7.27	- About 46% of the quarries visited were workin without permission. See Chapter 6, Paragraph 6.3.2.1
	- Thirteen respondents stated that the work permission can be obtained from different sources such as local authority, county governments and Ministry of Industry. See Table 7.7	- Twenty four respondents stated that there is more than one organisation who granted working permission and this caused conflict between government organisations and the planning system. See Chapter 7, Paragraph 7.6.3.1	- There are four kinds of permissions which hav been identified from the fieldwork visit, permission from local authority, county governments, Ministry of Industry and Ministry of Transportation. See Chapter 6 Paragraph 6.3.2.1
	- Eight quarry managers stated that there is a lack in the current permit/ licence procedure because it does not ask for any environmental requirements. See Chapter 7 Paragraph 7.5.3.2	- Twenty four respondents stated that the current permit/ licence procedure is not adequate and requires a budget to set up the necessary programmes to improve it. See Chapter 7 Paragraph 7.6.3.1	- The current permit/ licence procedure is very weak and needs to be improved to comply wit industrial development. See Chapter 2 Paragraph 2.14
The environmental impacts	- Thirty six respondents stated that environmental protection is not a major concern of the aggregates industry also there is no system introduced by which employees can make reports on environmental impact. See Chapter 7 Paragraph 7.5.4.2 and Table 7.11	- Fifteen respondents stated that environmental protection awareness is very limited in the aggregates industry and that is due to the absence of the environmental department in the aggregate companies and lack of joint consultation between the aggregate industry and government organisations in relation to environmental issues. See Chapter 7 Paragraph 7.6.4	- The fieldwork visit shows that the environment protection awareness in the aggregate companies and the government organisations very weak and also there was no system whic allowed their employees to make their own feelings about environmental impact known or to report environmental impact incidents. See Chapter 6 Paragraph 6.3.1.2
	- Thirty six respondents stated that there is a lack of effective environmental protection training carried out generally in a comprehensive manner in the aggregate industry. See Table 7.12 - Twenty three respondents stated that there is lack of communication between staff and their supervisors and managers in relation to environmental matters. See Chapter 7, Paragraph 7.5.4.1	- Twenty respondents stated that the government organisations' did not offer any courses or training to the aggregates industry in relation to environmental protection. See Chapter 7, Paragraph 7.6.4 - Eighteen respondents stated that there is lack of experts and absence of master plan for environmental protection training and development in the country. See Chapter 7, Paragraph 7.6.4	- The organisations monitoring and controlling t quarrying industry are incapable of stopping its environmental impacts. See Chapter 6 Paragraph 6.3.2 - There were no master plan for environmental protection training and development has been found during the field visit and also the aggregates companies do not require their nev employees to receive orientation training befor they start their duties. See Chapter 6 Paragrap 6.3.2.5

	- Nineteen respondents stated that aggregate extraction in Libya creates a lot of environmental impacts such as dust, noise, traffic etc... and nothing has been done to reduce these impacts. See Chapter 7 Paragraph 7.5.4.4	- Twenty three respondents stated that the extraction of aggregate has created a lot of environmental impacts and nothing has been done to control or reduce these impacts. See Chapter 7 Paragraph 7.6.4.1	- There are a lot of environmental impacts created by the aggregates industry which can be seen from the photos in Chapter 6 (e.g. Plates 6.3, 6.5, 6.9, 6.13, 6.22, and 6.27).
	- Ten respondents said that the machines and equipment used in the aggregates industry are not in good condition. See Chapter 7 Paragraph 7.5.4.4	- Twenty seven respondents stated that large numbers of machines and equipment used to produce aggregates are in bad condition and did not meet the environmental standards, and this created a lot of environmental issues. See Table 7.30 and 7.31	- Some of the machines and equipment used to produce aggregate in the quarries visited are i[n] bad condition. See photos in Chapter 6 (e.g. Plates 6.9 and 6.46).
	- Fourteen respondents stated that quarry sites are placed near major cities and towns to meet local demand and to decrease the transportation cost. See Chapter 7 Paragraph 7.5.4.4	- Twenty seven respondents stated that placing the quarry near the populated areas to meet the local demand has been creating a lot of environmental impacts. See Table 7.30	- The numbers of quarry sites has increased to meet the demand for aggregates which create[d] a lot of environmental impacts. See Table 6.3. - Quarries often placed near the populated area[s]. See photos in Chapter 6. (e.g. Plates 6.1 and 6.3)
	- Twelve respondents stated that primary aggregates are the only source of aggregates produced in Libya. See Chapter 7 Paragraph 7.5.4.4	- Twenty two respondents stated that primary aggregates are the only source of aggregates in Libya. See Table 7.30	- The documents collected during the fieldwork show that primary aggregates are the only source of aggregates in Libya. See Chapter 2 Paragraph 2.10.2 - The Libyan government does not give loans o[r] help to produce an alternative aggregates products. (Quarry Managers 1,3 and 4) see Table 7.3
The environmental laws and regulations	- Twenty two respondents stated that quarry staff did not follow the environmental laws and regulations. See Chapter 7 Paragraph 7.5.5.1 and Table 7.16	- The Government organisations' employees are aware of the importance of the environmental laws and regulations, but they did not follow them. See Chapter 7 Paragraph 7.6.5 and Table 7.33	- Field observations suggest that many companies are financially weak and that the Libyan Government needs to provide financial support to the aggregates industry to impleme[nt] the environmental laws and regulations. See Chapter 6 Paragraph 6.3.2.2
	- Twenty five respondents stated that the environmental laws and regulations are not implemented in the aggregates industry. See Chapter 7 Paragraph 7.5.5.1	- The environmental laws and regulations are not implemented or are ignored and the role of the government organisations' is absent. See Chapter 7 Paragraph 7.6.5	- "The EGA and the local authority are responsible for implementing the environment[al] laws and regulations but they did not force the aggregate industry to follow the stated environmental laws and regulations" (Senior manager 3, see Table 7.3)

	- Thirty six respondents stated that there was no environmental management system (EMS) in the Libyan Aggregates Industry. See Table 7.19	- Ten respondents said that there is a lack of understanding of environmental management systems (EMS) in the EGA and the local authority. See Chapter 7 Paragraph 7.6.5.1	- There is misunderstanding of the importance the EMS in the Libyan context in general and the case study organisation in particular. (Environmental report, 2002) - The Libyan Government does not help in EMS implementation. See Chapter 6 Paragraph 6.3.2.3
	- Twenty five respondents stated that large numbers of quarry staff do not know the environmental laws and policies in relation to quarrying activity and that they are not of major concern to them. See Table 7.18	- Eighteen respondents said that the government organisations' did not assist the aggregate industry with latest environmental laws and regulations applying to it. See Table 7.35	- According to the field visits the government organisations did not assist the aggregate industry with latest environmental laws and regulations as required by the planning syster See Chapter 6 Paragraph 6.3.2.2
The local authorities role in the planning system	- Twenty eight respondents stated that they did not submit any environmental protection plan about their quarry and they were not required to do so by the local authority. See Chapter 7 Paragraph 7.5.6.1 and Table 7.20	- Seven respondents said that the local authorities did not ask the quarry owners to produce an environmental protection plan before granting them permission. See Table 7.39	- The local authorities must ask quarry owners an environmental protection plan before granting them permission, as stated by laws a regulations. See Chapter 2 Paragraph 2.12.2. - There were no environmental protection plans available in the forty four visited sites
	- Thirty six respondents stated that the local authority did not ask the aggregate companies to submit the end-use plan for their quarry before granting permission. See Chapter 7 Paragraph 7.5.6.1 and Table 7.21	- Six respondents said that the local authorities did not ask the quarry owners to produce the development proposal that includes the end-use of the quarry site before granting them permission. See Table 7.40	- The local authorities must ask quarry owners an end-use plan before granting them permission, as stated by laws and regulations See Chapter 2 Paragraph 2.12.2.1 - There were no development proposals that includes the end-use of the quarry site availab in the forty four visited sites
	- Twenty two respondents stated that the local authority did not supply the aggregate industry with the stated environmental laws and regulations applying to them and did not help the Industry to implement those laws and regulations and follow them. See Table 7.22	- Six respondents said that the local authorities did not supply the quarry owners with the current environmental laws and regulations that apply to quarrying. See Table 7.41	- The local authorities must supply the quarry owners with the current environmental laws ar regulations that apply to quarrying. See Chapt 6 Paragraph 6.3.2.2
	- The quarry staff stated that they did not receive any visits from the local authority for work inspection. See Chapter 7 Paragraph 7.5.6.1	- Nine respondents said that the local authorities did not visit the quarry sites for work inspection. See Table 7.42	- The local authorities has the power to control and monitor operations of quarries. No eviden of monitoring was found during the field visit. - The local authorities have power to close any site making environmental impacts. but no quarries have been closed under these power (inspector 9, see Table 7.3)

The environmental institutions role in the planning system	- Thirty six respondents stated that government organisations did not give them any kind of assistance or advice in regards to the environmental protection measures. See Chapter 7 Paragraph 7.5.7.1	- Fourteen respondents stated that the environmental institutions did not give any assistance or advice to the quarry owners in regards to the environmental protection. See Table 7.45	- According to the stated laws and acts the environmental institutions must give assistanc and advice to the quarry owners in regards to the environmental protection. However there was no evidence for assistance or advice from the environmental institutions.
	- Thirty six respondents stated that they did not receive any visits from the local environmental organisations for work inspection. See Chapter 7 Paragraph 7.5.7.1	- Twelve respondents stated that the environmental institutions did not visit the quarry sites for work inspection. See Table 7.46	- One of the most important roles of the environmental institutions is the work inspectio to stop the aggregates industry from degradin the environment. but the environmental institutions did not visit the quarry sites for wor inspection (Department manager 3, see Table 7.3)
	- Thirty six respondents stated that the government organisations did not offer us any courses, seminars; leaflets etc… in relation to environmental protection. See Chapter 7 Paragraph 7.5.7.1	- Eleven respondents stated that the environmental institutions did not offer to the quarry owners any courses, seminars, leaflets etc… in relation to environmental protection. See Table 7.47	- The environmental institutions were establishe to protect the environment and help industry t improve environmental protection. See Chapte 2 Paragraph 2.11.1
Social and cultural influences	- People's social relationships with family and tribe influenced the process of obtaining permission, which is often obtained without completing all the necessary documents. See Chapter 7 Paragraph 7.5.3.3	- Fourteen respondents stated that some of the government organisations' employees did not follow the procedure for opening a new quarry due to their social relationships with family and tribe in the Libyan communities. See Chapter 7 Paragraph 7.6.3.1	- The senior managers in the government organisations' stated that peoples social relationships with family and tribe is the main reason for quarry works without permission
	- Eight respondents said that there is a lack of communication between the aggregates companies and the government organisations' due to family and tribe. See Chapter 7 Paragraph 7.5.5.1	- Thirteen respondents stated that communication processes between the government organisations and the aggregates industry were very strongly influenced by cultural factors. See Chapter 7 Paragraph 7.6.3.1	- According to the top managements in the loca authorities, the Libyan and Arabic cultural influences have negatively affected the public organisations and its development. See Chap 2 Paragraph 2.9

8.2. Findings Related to Work Permission

In order to assess the work permissions in Libya the quarry staff and the government organisation employees were asked a series of questions and the findings from these questions will be analysed in the following section.

8.2.1 Quarries Working without Permission

According to the Libyan regulatory regime all quarry sites must have permission before they start working (see Chapter Two), but what has been found from the quarry staff questionnaires and government organisations' employee's interviews is that there are large numbers of quarries working without permission.

Some of the quarry staff stated that they did not have permission in their quarry due to good relationships with family and tribe in the government organisations which allowed them to work without permission or to renew their permission. In this respect, the government organisations' employees were asked about the reasons for those quarries to work without permission and why the government organisations did not force them to have permission. The respondents stated the following:

1. Lack of or poor implementation of laws and regulations;
2. Lack/absence of local authority role;
3. Lack/absence of the environmental institution role (EGA, IRC);
4. Lack of qualified staff in the County (Al-Shabiat) government;
5. Lack of experts in the Ministry (Popular Committee) of Industry.

These findings from the questionnaires and the interviews are supported by the evidence gathered from documents and the fieldwork, which clearly indicates that half of the Libyan quarries work without permission and the government organisations did not force them to have permission. This documentation is supported by the additional comments of the senior managers in the EGA which emphasised why their organisations did not stop those quarries from working without permission; they stated that the lack of budget and the absence of communication between the government organisations allowed those quarries to avoid the need to renew their permission or allows them to open a new quarry without permission.

Such a situation would imply that the government organisations' did not take work permissions seriously, which led to little control of the aggregates industry. Significantly, there were a number of employees in the EGA who felt that the work permission procedures in which they had taken part were good or acceptable, but who also felt there was need for improvement to the current licence procedure to comply with industrial development.

8.2.2 Organisations Granting Permission

According to the planning systems and fieldwork findings the government organisations have a wide range of roles and responsibilities. In this respect, the government organisations' employees were asked about their organisation's main role of granting work permission. Unanimously the EGA and the local authorities' employees reported that their organisations are included in the licence procedure and have great power to minimize the environmental impacts and maintain sustainable development in the aggregate industry. As stated by the EGA (2004A), the Libyan government has given the environmental institutions and the local authorities a wide range of roles and responsibility to protect the environment.

It has been noticed from the questionnaires and the interviews that the permission to open a new quarry in Libya can be obtained from different sources such as local authority, county governments, Ministry of Industry and Ministry of Transportation; This has caused conflict between these institutions and allowed the number of aggregate sites working without permission to increase. This finding has been supported by both documentary evidence from the case study organisations and the fieldwork visit, which indicated that work permission can be obtained from different government organisations.

Additionally, in the interviews, the employees made it clear that due to deficiencies in the government organisations' budget and the lack of communication between them there was no opportunity for these organisations to play all of their roles and responsibilities in the field of environmental protection. Additionally some of the respondents from the EGA emphasised that the serious lack of a dedicated budget allocated to solve the environmental issues (e.g. quarrying impacts) made the authority incapable of complying with all of the environmental challenge.

8.2.3 The Current Licence Procedure

As stated in Chapter Two the current Libyan licence procedure goes back to 1984, so it is important to investigate if this licence procedure is adequate and controls the aggregate extraction. According to some of the quarry managers, there is a deficiency in the licence procedure and that allowed some of the quarry owners not to have to renew their quarry licence, with a resulting increase in environmental issues.

In order to fulfil this finding the government organisations' employees were asked to express their thoughts about the current licence procedure for opening a new quarry. Significantly, there were large numbers of respondents (24 out of 30) who felt that the current licence procedure is not adequate and their organisations did not control the work permission and the environmental impact created by the aggregate industry. The respondents emphasised that this failing was due in their opinion to a number of reasons such as the serious lack of budget, lack or poor implementation of the environmental laws and regulations and lack of communication between the government organisations. Additionally, all of the respondents supported the idea that the current licence procedure would require a budget to set up the necessary programmes to improve it. Furthermore, the senior managers considered an evaluation of current licence procedure as the first important step toward the introduction of a proper licence procedure, which they felt should initially be targeted at the most obvious areas of concern.

8.2.4 Respondents Suggestions on How to Improve the Current Licensing Procedure

Interviews participants suggested the following in improvements to the current licensing procedure:

- The investor must submit the environmental impact assessment (EIA) report on any new quarry before getting the permission;
- All the government organisations must have highly qualified staff to monitor the aggregate industry and to run work inspection;
- The government must introduce a system which can be used to link all government organisations to stop misfeasance of granting permission;
- The local authorities must ask the investor to provide money as guarantee for site restoration;
- The permission must have limited time;
- The government must provide sufficient budget to its organisations to do the work properly.

8.3. Findings Related to the Environmental Impacts

A wide range of environmental impacts has been created by the aggregate industry as can be seen in Chapter Six. In this regard the government organisation employees were asked a series of questions and the findings from these questions will be analysed in the following sections.

8.3.1 Awareness of Environmental Protection

The quarry staff were asked to state if they are aware of the importance of environmental protection. The majority of them said they are not aware of it. All of the staff who responded "no" indicated their belief that the absence of an environmental department in their quarry and the lack of communication between them and their supervisors and managers in environmental matters is the main reason for this misunderstanding. Furthermore some of the quarry managers stated that the local authority and environmental institutions gave no opportunity to quarry staff to attend courses or workshops to improve their skills in the field of environmental protection.

On the other hand, all of the organisation's respondents stated they are aware of the importance of environmental protection, and they stated their organisation has comprehensive roles and responsibilities covering all sorts of industrial development such as the aggregate industry and its environmental issues in the environmental protection plan. The three organisations stated different roles which can be summarised as follows:

The EGA staff stated that their organisation's main roles are:

1. Spreading environmental awareness in society through the media;
2. Visiting the affected places and trying to improve their environmental condition;
3. Producing annual reports about the projects making environmental impacts.

The local authorities' staff stated that their organisation's main role is:

1. Implementing environmental laws and regulations and forcing the industry to follow them;
2. Penalise any project making an environmental impact. This could be done by the project company through paying money to solve these environmental problems or by the local authority cancelling their working permission.

The IRC staff stated that their organisation's main role is:

1. Control of pollution particularly of industrial origin such as oil and fuel spills;
2. Control of products such as aggregates, ensuring that the product is high quality and matches standard specification.

According to the fieldwork and the documents collected from the government organisations and the Ministry of Industry about what has been achieved concerning the above points in the past ten years, all of them stated that what has been achieved is very little. They emphasised that this lack of achievement puts these organisations under pressure from the General Peoples Committee, because the General Peoples Committee is the main supervisor of the case study organisations and it is its responsibility to ensure those organisations do their part as stated in the planning systems.

Additionally, it has been found from the fieldwork that there is no environmental department in any of the sites visited as all quarry staff respondents stated that there was no system that allowed them to report environmental impact incidents. Also a number of respondents stated that there was no system of joint consultation for environmental protection between the aggregate industry and government organisations to discuss environmental protection matters. This finding indicates a lack of communication between the aggregate industry and the government organisations even in such an important area as environmental protection.

8.3.1.1 Environmental Protection Training

The majority of the questionnaires and the interview respondents stated that there was no training related to environmental protection in the aggregate industry. Clearly this finding indicates a lack of relevant and effective environmental protection training carried out generally in a comprehensive manner in the aggregates industry. This is to some extent because environmental programmes are not planned and there is no adequate co-ordination of environmental protection training in the industry. Furthermore the government organisations did not offer the aggregates industry any courses or training related to environmental protection.

These findings from the questionnaires and the interviews are supported by the evidence gathered from documents and the fieldwork, which clearly indicates that environmental protection is not of major concern in the Libyan aggregates industry and the government organisations did not help the industry to improve its environmental protection. This documentation is supported by the suggestions which have been made by some of the respondents concerning how to improve environmental protection in the aggregates industry. The suggestions were as follows:

1. The government organisations should help or offer environmental protection training to the quarry staff;
2. The government organisations should help the aggregate industry to implement the environmental laws and regulations;
3. There should be an environmental department in all aggregate companies.

8.3.2 Environmental Impacts from Aggregate Extraction

As stated earlier the environmental impacts from aggregate extraction in Libya are very serious and this led the author to ask the respondents specific questions to indicate whether the operation of their quarry affected the environment. The majority of the respondents (19 out of 36) said they have environmental impact in their quarries. The findings from this question are significant because it is further proof that aggregate extraction is creating environmental impacts.

Furthermore the respondents who said they have environmental impact in their quarries stated that they did not take any measures to reduce these environmental impacts. This finding suggests that quarry staff know that their quarries are affecting the environment and that they do not attempt to reduce those impacts. This indicates that the environmental laws and regulations are not implemented or are ignored and the role of the government organisations is vague.

In order to understand if the government organisations' respondents are aware of the environmental impacts created by the aggregate extraction or if there is research done in their organisation concerning this matter, the respondents were asked to state what are the main reasons for the current environmental impacts of the aggregates industry; they identified the following:

8.3.2.1 Machines and Equipments Used in the Aggregates Industry

According to some respondents in the aggregates industry the machines and equipment used to produce the aggregate are in poor condition. Some of the quarry managers' emphasise this is due to financial difficulty in some of the aggregates companies.

In order to support the previous finding, the government organisations' employees were asked about the machines and equipment used in the aggregates industry. The majority of the respondents stated that the machines and equipment used to produce the aggregate have created a lot of environmental issues, because they are in bad condition or out of date. This finding has been supported by fieldwork findings (Chapter Six) as can be seen from the photographs.

8.3.2.2 The Location of Quarry Sites

In Libya large numbers of quarry sites were found close to urban cities or close to the main roads. In this regard the quarry staff were asked to state why the quarry sites are located near the populated areas. The majority of the respondents stated that the reason was to meet local demand and decrease the transportation cost. On the other hand the government organisations' respondents stated that placing the quarry sites near major road or close to public communities has created a lot of environmental impacts such dust, noise etc...

Significantly, there were a number of respondents who felt that opening of quarry sites near major roads or close to public communities could be due to deficiencies in the organisations monitoring and controlling the quarrying industry. This finding supports the conclusion of the fieldwork which suggested that the large numbers of environmental impacts created by the aggregates industry were due to lack of role from the government organisations'.

8.3.2.3 The Source of Aggregates

As stated in chapter two in Libya primary aggregates are the only source of aggregates used by the industry; in this regard the quarry staff were asked to state if this is one of the reasons for current environmental impacts, the majority of them said "yes". This finding has been supported by large numbers of government organisations employees.

According to some of local authorities' employees the Libyan government did not give loans or help to produce alternative aggregates products, which led to more production of primary aggregates. As a result the environmental impacts have increased especially in the last 15 years.

8.3.2.4 Complaints about Environmental Impacts

As stated earlier the Libyan aggregates industry creates a lot of environmental impacts. So the government organisations' employees and the quarries staff were asked to state if they get complaints from the neighbouring residents or land owners about the environmental impacts, the respondents agreed and identified the following complaints:

1. Impact from dust, noise, blasting etc...due the closeness of the quarry sites to the residential areas;
2. Impact on landscape by leaving the quarry open after the work finished;
3. Impact to ground water from oil and fuel spills;
4. Impact to ground water from sea water intrusion when extracting the aggregates below the sea water level the saltwater moves into the

aquifer so that wells drilled on upland areas cannot obtain freshwater suitable for public consumption.

These findings are supported by some complaints papers, which the researcher has collected during his field study. Most people were complaining about the closeness of the quarry sites to the residential areas and the impact of these quarries to ground water. The researcher visited some of the neighbourhoods near the quarry sites and asked them about what the government organisations did with their complaints; the vast majority said nothing has been done so far.

8.3.3 Suggestions as to how to Improve the Environmental Impacts of the Aggregates Industry

Additionally, the government organisations respondents stated that the Libyan government must do the following to reduce the environmental impacts of the aggregates industry. Their suggestions are as follows:

1. There must be an environmental impact assessment report for any new project;
2. The permission procedure system must follow the environmental laws and regulations also the guidance notes provided by the EGA and IRC;
3. The quarry land must be industrial land and agreed by the Ministry of Industry;
4. The government must encourage companies to use the secondary aggregates and help them to produce more alternative products;
5. The equipment used to produce aggregates must be compatible with the environmental standards.

8.4. Findings Related to the Environmental Laws and Regulations

It was established in the literature review (Chapter Two) and the fieldwork (Chapter Six) that the environmental laws and regulations are not implemented in Libyan industry in general and in the aggregates industry in particular. This finding leads the author to investigate the understanding of the environmental laws and regulations in the aggregates industry and in the government organisations as well as the barriers to their implementation.

8.4.1 The Importance of Environmental Laws and Regulations

In the feedback from the quarry staff, it was pointed out that there has been lack of understanding of the environmental laws and regulations in the aggregates industry. On the other hand the feedback from the government organisations shows that all of the respondents are aware of the environmental laws and regulations. This finding has been supported by the fieldwork result which shows that there is no environmental department in the aggregates companies and the environmental laws and regulations are not implemented or were ignored.

The respondents from the government organisations were asked to state if their organisation was involved in the implementation of the environmental laws and regulations. The industrial research centre employees responded negatively. The reason for this negative response is that the IRC is a technical organisation and its environmental role is limited. The environmental general authority staff said "yes" their organisation is involved in the implementation of the environmental laws and regulations. The main role of the EGA is producing the guidance notes and providing the new projects with the environmental laws and regulations that apply to them (EGA, 2004A). But some of the EGA staff stated that their organisation does not do this role at the present time due to lack of budget and lack of communication with other government organisations.

The local Authorities staff stated that they are involved in the implementation of the laws and regulations. The main role of the local Authorities is making sure that the laws and regulations are fully implemented and cover all sources of development (Masoud, 1998). However senior managers in the local authorities stated that local authorities' roles in the planning system is lacking due to a number of reasons such as lack of qualified staff, lack of understanding of the laws and regulations and the effects of social relationships in the Libyan culture on the government organisations'.

8.4.2 The Barriers Facing the Implementation of the Environmental Laws and Regulations

The case study organisations, like many other Libyan organisations still manage in traditional style where every manager and department has major responsibilities, and work separately using a top-down management approach, a fact which has been confirmed during the field visit. In order to understand the main obstacles facing the implementation of the environmental laws and regulations in the Libyan Aggregate Industry, the respondents in the three case study organisations were asked to state what obstacles they faced in implementing the environmental laws and regulations. They stated the following:

1. A lack of commitment from the relevant department to implement the laws and regulations;
2. Conflict between the organisations in granting permission;
3. Disregard of the EGA role from other government organisations;
4. Shortage of qualified staff to implement the laws and regulations;
5. Financial difficulty in some of the aggregates companies.

This finding has been supported by the fieldwork result, which stated in the paragraph 6.3.2 that ignoring of laws and regulations and the lack of qualified staff to do the work in the government organisations are the main reasons for most of the environmental impacts in the aggregates industry. On the other hand the author asked some of the respondents if there is any plan to overcome these problems. All of the respondents said no, and added that without help from the Ministry of Industry it is not possible for them to overcome these problems.

8.4.3 Absence of Environmental Management Systems (EMS)

The respondents from the aggregates industry stated that they have no environmental management systems (EMS) in their quarries. So this result supported the previous findings which show that the majority of the quarries visited have no environmental plans and the environmental laws and regulations are not implemented. The respondents were asked about the reasons why they did not implement EMS in their quarry. Their answers are summarized as follows:

1. High implementation cost;

2. Lack of government pressure or support;
3. Lack of expressed interest by staff or training for staff.

The previous findings indicate that government needs to provide financial support for environmental laws, regulations and EMS implementation. The author also found out that from the documents the quarry that staff never participated in any training or programmes concerning EMS or environmental protection in general, which could be the major obstacle hampering the environmental laws, regulations and EMS implementation in the aggregates industry.

8.4.4 Lack of Understanding of the Environmental Laws and Regulations In Relation To Quarrying Activity

Feedback from the quarry staff show that the environmental laws and policies in relation to quarrying activity are not known to large numbers of the aggregate industry employees and are not of major concern to them. The vast majority of the government organisations staff are aware of the environmental laws and regulations applying to the aggregates industry. This particular finding clearly demonstrates that the government organisations did not supply the aggregate industry with the latest environmental laws and regulations applying to them and did not help the industry to implement those laws and regulations and follow them.

The government organisations' respondents were asked to state why their organisations did not assist the quarry owners. The three organisations gave different reasons. The EGA staff stated that their organisation did not assist the quarry owners with the relevant laws and regulations because a large number of the quarry sites work without EGA permission. The IRC staff stated that their organisation is a technical organisation and does not have any connection with quarry owners in such areas. The local authorities' staff stated that they are responsible for assisting the quarry owners with current environmental laws and regulations and making sure that the quarry owners comply with them, but unfortunately their organisation did not do this at the moment due to various reasons such as lack of qualified staff, lack of communication with other government organisations, and lack of budget.

8.5. Findings Related to the Local Authority's Role in the Planning System

The literature review and the fieldwork results show that the local authorities' role in the planning systems is largely absent. This finding leads the author to investigate why the local authorities' role is absent and to what extent does this affect the aggregates industry

8.5.1 The Environmental Protection Plan and the Local Authority

The local authority employees know that their organisation has the statutory powers pertaining to planning, development and management of environmental protection. The feedback from the respondents stated that the local authorities have the power to control the aggregates industry and manage its environmental impacts, but the local authorities role was absent in controlling the environmental impact and helping the aggregates industry to minimise its effects on the environment.

This finding was supported by the feedback from the aggregates industry staff which stated that the local authorities did not ask them for an environmental protection plan or the end-use plan for their quarry before granting them permission and this means the local authorities did not follow the procedure for opening new quarries which is specified by the planning system (see chapter 2). Some of the respondents emphasised this lack of role was due to the following:

1. Serious lack of a dedicated budget allocated to the local authorities;
2. Lack of qualified staff and equipment;
3. Some of the local authority staff think that environmental issues are not part of their organisation's role;
4. People's social relationships as discussed in paragraph 2.9 (chapter two) force some of the staff to ignore important documents such as the environmental protection plan.

These findings seem to be consistent with those collected during the field visit and from the documents collected from the local authorities, but the senior managers in the local authorities stated that the most important barrier preventing local authorities from undertaking their roles and responsibilities in the field of environmental protection is the people's social relationships resulting from the family and tribe ties in the Libyan community, as discussed by the researcher in chapter two.

8.5.2 Local Authority Role in Implementing the Environmental Laws and Regulations

Another important new finding of this study is that the local authorities did not supply the aggregates industry with a copy of the current environmental laws and legislations applying to quarrying. According to the planning system the local authority must provide the aggregates industry with current environmental legislation that applies to quarrying. This finding proved that the environmental laws and regulations are not of major concern to the local authority employees. This finding could be the main reason for not implementing the environmental laws and regulations by the aggregates industry and also the reason for misunderstanding of the current environmental laws and regulations by the aggregates industry staff.

8.5.3 Local Authority and the Work Inspection

Another significant finding is that the aggregates industry staff stated that they did not receive regular visits from the local authority for work inspection, which means again the local authority did not play one of its major roles and responsibilities as stated by the planning system. These findings could be the reason for not implementing the environmental laws and regulations in the aggregate industry.

8.5.4 Suggestions as to how to Improve the Local Authority Role in the Planning System

The previous findings show that the local authority role in the planning system is very weak and needs to be improved to control the aggregate extraction and improve environmental protection. The local authorities' employees were asked to state what their organisation must do to improve its roles and responsibility in the field of environmental protection. The respondents stated the following:

1. The local authority must not grant permission to any quarry without completing all the necessary documents;
2. The local authority must prepare specialised technical cadres to monitor the aggregate industry and to run work inspection and produce weekly or monthly reports about it;
3. The local authority must give more roles to the environmental institutions such as stipulating that all quarry sites must have environmental permission from the EGA;
4. The environmental institutions must prepare courses and seminars for the aggregate industry and the government organisations' staff, and also produce magazines and TV programmes to educate citizens;
5. The local authorities must activate the environmental laws and the regulations and force the aggregate industry and the government organisations to follow them.

8.6. Findings Related to the Environmental Institutions' Role in the Planning Systems

The literature review and the fieldwork results show that the environmental institutions' role in the planning system is absent. This finding leads the author to investigate why the environmental institutions' role is absent and to what extent does this affect the aggregates industry.

8.6.1 Environmental Institutions' Role and the Aggregates Industry

The respondents were asked if their organisation has any branch/office outside the headquarters. The respondents from the EGA stated "yes" and they mention that there is an office in every state (AL-Shabiat). But these are not separate offices, they are supervised by the Ministry of Health local offices and that makes them ineffective. The IRC staff said "no" there is only one office which is located in Tripoli because the IRC is a technical institution and its involvement in the aggregate industry is limited to technical advice.

This finding is particular to the Libyan context, and is due to a lack of management structure in the Libyan organisations. Additionally, this mix of roles and responsibilities between the Ministries and organisations has negative results on the outcome of the environmental protection programmes. However, evidence from this study shows that there is also a lack of communication between the EGA and IRC and this appears to be another barrier to the effective role of the environmental institutions.

This finding was supported by the feedback from the aggregates industry staff which stated that the environmental institutions did not offer any help or advice in regard to environmental protection, which means that the environmental institutions did not play their roles as stated in the environmental laws and regulations. The environmental institutions' respondents stated the following as the main reasons for not giving any help or advice in the aggregates industry:

1. Large numbers of the quarry owners work without environmental permission;

2. The local authority did not help the environmental institutions to play their part in the environmental protection scheme;
3. The budget allocated to the environmental institutions is very small compared to its role and responsibility.

Another significant finding is that the environmental institutions' employees stated that they did not provide guidance notes, courses, seminars, leaflets and magazines to help to improve environmental protection awareness in the aggregates industry as required by their established laws and acts. This finding is very important because it proves that the environmental institutions did not help the industry to improve the environmental conditions in their sites, therefore the Libyan government must find a way to ensure that the environmental institutions play their roles and fulfil their responsibility as stated in their established laws and acts.

These findings seem to be consistent with those collected during the field visit and from the documents collected from the environmental institutions, but the most important barrier facing the environmental institutions in carrying out their roles and responsibilities in the field of environmental protection is the local authority ignoring the environmental institutions' roles in the planning system.

8.6.2 Environmental Institutions and the Work Inspection

Another important finding in this study emerging from interview respondents is that the environmental institutions did not send inspectors to check the work in the quarry sites as required by the Libyan Regulatory Regime, which means the environmental institutions did not undertake one of their major roles and responsibilities as stated by the planning system. This finding could be the reason for not applying for the environmental permission by the aggregate companies.

This finding is supported by the quarry staff answers and fieldwork results, which stated that the environmental institutions' roles in the planning system are vague. Some of the respondents emphasised the lack of quarry visits due to the lack of budget, shortage of equipment and qualified staff to do the work and lack of direct contact between the environmental institutions and the quarry owners because most of them work without environmental permission.

As the previous findings show, the environmental organisations' role in the planning systems is unsatisfactory according to its established laws and acts. So the author asked the environmental organisations' employees what are the difficulties facing their organisations and preventing them from playing their role in the planning system. The respondents put forward the following difficulties:

1. Lack of cooperation from other government organisations;
2. Shortage of equipment and qualified staff to do the work;
3. Conflicts of roles and responsibilities between government organisations;
4. Lack of understanding of the IRC role in the planning systems from all government organisations.

Some of the senior managers suggested that the Prime Minister's (Secretary of the General People's Committee) office must give more priority to the environmental institutions to help them to protect the environment and play their part as stated in the planning systems.

8.6.3 Suggestions on How to Improve the Environmental Institutions Role in the Planning System

The previous finding proved that the environmental institutions' role in the planning system is very weak and needs to be improved to protect the environment. The environmental institutions employees were asked to state what their organisation must do to improve its roles and responsibility in the field of environmental protection. The respondents stated the following:

1. The environmental organisations must study the environmental impact assessment report carefully before granting permission to any new quarry;
2. The environmental institutions must prepare specialized technical cadres to monitor the aggregate industry and to run work inspection to minimise adverse environmental impact;
3. The environmental institutions must prepare courses and seminars for the aggregate industry and the government organisations staff;
4. The environmental institutions need to use public media such as TV and newspapers to educate people about the importance of the environmental protection;
5. The environmental institutions must ask for more money from the government to do their part comprehensively.

8.7. Findings Related to Social and Cultural Influences

Feedback from the respondents in the case study organisations shows that they agree with the views highlighted by the fieldwork which stated that social and economic factors can create barriers to environmental protection and its development. The feedback from senior and department managers to the interview questions indicated that barriers can occur due to the influence of tribe as well as family relationships. One obstacle to effective environmental protection training was employee absenteeism from work in order to attend social events and ceremonies that resulted from family and tribal connections. It was noted that a high percentage of absenteeism was recorded on Wednesdays and Thursdays, which are the days when wedding parties and other social events and ceremonies are held according to Libyan traditions. Such levels of absence cause delays in work and in some cases even prevent work from being completed, such as granting permission without completing the necessary papers.

This finding is particular to Arab and other African organisations because the family, tribe and social ties are prevalent in these cultures. Additionally, senior managers felt that as the case study organisations are situated in the public sector and under government control, employees did not bother whether their jobs were finished or not, and they were not overly concerned by the effects of their absences, as they did not perceive their futures to be connected with the future of the organisation.

All of the respondents in the research believed that communication processes between the government organisations and the aggregates industry were very strongly influenced by the organisational culture. The senior managers agree that such an effect on communication processes within an organisation will create barriers to environmental protection and its development. The presence of traditionally-managed government-controlled organisations in Libya as well as the influence of society and culture means that the creation of an environment where employees are encouraged to engage in their own continual self-development is difficult as the influence of tribe and family has an impact on the actual allocation of positions opportunities and on employees' willingness to accept these.

8.8. Recommended Guidelines for Improvement of Environmental Management in Aggregates Industry

The findings of the research have highlighted the main environmental impacts of the aggregates industry and why the current regulatory regime has failed to control them. This has enabled recommendations to be formulated as guidelines to the Libyan government that will help towards reducing the actual and perceived environmental impacts of aggregate extraction.

8.8.1 Recommended Guidelines to Improve Procedures for the Granting of Work Permission:

1. In order to control work permissions, the government should introduce a system which can be used to link all government organisations to stop misfeasance of granting permission;
2. The work permission should not be left open and must be time limited;

3. The permission procedure system should be based on the environmental laws and regulations and also the guidance notes provided by the EGA and IRC;
4. In order to reduce the numbers of quarries working without permission the local authority must not grant permission to any quarry without it first completing all the necessary documents;
5. The local authority should stipulate that all quarry sites must have environmental permission from the EGA, before applying for work permission;
6. There should be an environmental impact assessment (EIA) report on any new quarry before getting permission;
7. The environmental organisations should study the environmental impact assessment report carefully before granting permission to any new quarry;
8. All the government organisations should have highly qualified staff to monitor the aggregate industry and to run work inspection.

8.8.2 Recommended Guidelines to Improve the Management of Environmental Impacts:

1. There should be an environmental department in all aggregate companies in order to improve environmental conditions in the quarry and to provide training and courses to the workers with regard to the environmental issues on coordination with the government organisations;
2. The equipment used to produce aggregates should be compatible with environmental standards;

3. The environmental impacts should be mitigated as far as possible. This particularly applies to dust, which appears to be of major concern to all local communities; and which can be managed through use of water to reduce the dust emission and/or creation of buffer zones, windbreaks, Vegetated berms and Plantation of trees to restrict transport of dust by wind;
4. The site impact to the landscape should be minimised as far as possible, by ensuring that there is adequate screening especially along transport routes;
5. During the planning stage consideration should be given to the sites that offer alternative transport options such as water. Where this is not possible, haul routes off site should be planned, where feasible, to avoid hilly routes through town areas. This will assist in reducing the impact of traffic noise due to transport vehicles;
6. In order to stop leaving the quarry sites without restoration, local authorities should ask the investor to provide a band as a guarantee for site restoration;
7. The government should encourage companies to use secondary aggregates in order to reduce use of primary aggregates and help aggregates companies to produce more alternative products.

8.8.3 Recommended Guidelines to Improve the Implementation of Environmental Laws and Regulations:

1. The Libyan government should produce guidelines for all environmental impacts created by aggregates extraction like those used in the UK (e.g. MPG11);

2. The government organisations should provide the aggregate industry with information and guidance on environmental laws and regulations and help the industry to implement them;
3. The local authorities as the responsible organisations for implementing and enforcing all the laws and regulations should force the aggregate industry and the government organisations to abide by them;
4. The Libyan government should encourage procedures to implement EMS in the aggregates industry in order to improve environmental protection.

8.8.4 Recommended Guidelines to Improve the Effectiveness of Government Originations in Protecting the Environment:

1. In order to protect the environment and improve environmental awareness government organisations should help or offer courses, seminars and environmental protection training for aggregate industry staff and the government organisations' employees. It would also be beneficial to produce magazines and TV programmes to educate citizens;
2. The government organisations must provide the aggregates industry with latest environmental laws and regulations that apply to it and help it to implement them;
3. The government should provide sufficient budget for its organisations to enable them to fulfil their roles and responsibilities comprehensively;
4. There should be a master plan for environmental protection training and development in the country to be used as guidance when training policies are formulated;

5. The government organisations should visit the quarry sites regularly for work inspection as required by the environmental laws and regulations.

8.9. Limitations of the Research

Generally, research in the environmental impact of mineral extraction is not an easy task. This study has suffered from several limitations, and all possible efforts were made to overcome them and avoid their influence on the processes, findings, conclusions and recommendations of this study. The following provide a brief outline of these major limitations.

8.9.1 Lack of Previous Studies and Data

The design and subject matter of this study was subject to the constraints of availability of information and statistical data. Libya like most developing countries lacks skilled and well-qualified personnel, the know-how, and the sophisticated facilities needed to compile more comprehensive data that would serve all the purposes of social and economic development.

The documentation systems in the case study organisations and the aggregates industry were not comprehensive and the data available relevant to the research were characterized by fragmentation and contradiction and they were not classified or presented in an appropriate formats. In addition, no prior attempts had been made to analyse and interpret the data. Therefore many difficulties were experienced in gathering data and information relevant to the key issues of the research. In order to overcome this limitation, virtually all data had to be gathered personally by the researcher.

Empirically, the study focused only on three case studies in the Libyan government organisations and did not include calibration with other industrial organisations. Including other organisations and Institutions from the government organisations' and/or other sectors may have provided a wider and/or different understanding of environmental protection practices in the Libyan context. Access, time and cost constraints and the amount of work involved prevented the researcher from expanding the research setting.

8.9.2 Social and Cultural Circumstances

As the research is qualitative research, the researcher found a difficulty in the beginning to start the interview unless he brought a formal letter from the Libyan embassy stating that he is a fulltime research student because the research systems in Libya used to be quantitative research by using questionnaire survey not qualitative research. Once the researcher got the letter from the embassy and made good contact with people working in the case studies organisations, everything became much easier such as planning the interviews and going through all needed archival documents, which helped in carrying out this research.

The questionnaire was given to the aggregates industry staff, but, due to various levels of literacy among the employees at the aggregates industry, there may have been more employees who wanted to offer additional information, but who were unable to do so. These replies from aggregates industry staff were used to triangulate with the information supplied by the government organisations' employees.

CHAPTER NINE

Chapter Nine
Conclusions and Recommendations

9.1 Introduction

In this chapter the main findings of the research study are brought together and the main conclusions are presented. The research has provided an understanding of the main issues and constraints on environmental improvement in Libya. This has enabled recommendations to be prepared for the investors and the government organisations that will help towards reducing the actual and perceived environmental impacts of aggregate extraction. The contribution that this thesis makes to existing knowledge is described in this chapter, and recommendations for future research work are also made.

9.2 Overview of the Thesis

Throughout the discussion and the analysis of this thesis, the key aim has been to gain a better understanding of the general characteristics of the Libyan aggregates industry and its operation, its environmental impacts and the environmental laws and regulations controlling it.

A wide range of issues and topics with regard to the aggregates industry and its environmental impacts in Libya have been covered by this study. Libyan environmental laws and regulations have been examined from independence in 1952 with particular emphasis on the quarrying and mining policy in the 70s, 80s and 90s. The focus of the study was to assess the effectiveness of the implementation of the quarrying and mining policy adopted by the Libyan government for dealing with minerals extraction and its environmental impacts. In order to understand the aggregates industry and its environmental impacts in Libya, a wide ranging review of the aggregates industry in the world in general, and the UK in particular was undertaken in Chapter Three. The main environmental impacts associated with aggregate extraction were reviewed in Chapter Four. It has been recognised that from prospecting and exploration through post-closure, aggregate quarrying has the potential to cause considerable environmental impacts. However, the use of environmental laws and regulations in aggregate extraction may reduce, limit, and control many of these impacts but aggregate extraction will, to some extent, always alter landscapes and environmental resources. In Libya the regulatory regime consists of environmental laws and regulations, which if implemented properly could reduce environmental impacts in the aggregates industry.

At the beginning of the 1980s the Libyan government adopted a new environmental law called *Law No7 of 1982 in regard to environmental protection,* but that law has not been able to control the environmental impacts of aggregate extraction for various reasons such as absence of public awareness of the importance of the environment and lack of interest from government organisations. In the last ten years the Libyan government has realised that aggregate extraction is creating a lot of environmental impacts and something must be done to control the industry. Since the sanctions were suspended in 1999 in relation to Lockerby issues, the Libyan government has taken a number of steps to improve environmental protection and achieve sustainable development. These steps started with various amendments to its environmental laws and regulations such as producing Law No 15 of 2003 in protecting and improving the environment by the General Peoples Committee, which replaced *Law No7 of 1982 in regard to environmental protection*. On the other hand the Environmental General Authorities produced the guidance notes for the aggregates industry and these are the first guidance notes in the Libyan environmental regulations.

Principally, the research is about identifying and understanding the Libyan aggregates industry and its environmental impacts and assessing the effectiveness of the environmental laws and regulations to control these impacts. Many questions were posed in Chapter Five and have been answered in this study. The questions raised were: *Why has the Libyan aggregates industry created environmental impacts and why has the planning system been ineffective and failed to control them? What are the main environmental polices that have been adopted during the last two decades? Who are the parties responsible for implementing these polices? What are the main factors that make the planning regime ineffective? What can be done to improve the current planning regime?*

To achieve the aim of the study and to answer the research questions, various techniques were employed to collect the required data using both secondary and primary sources. Secondary data was obtained from government reports and censuses. Primary data was obtained from government organisation employees (Environmental General Authority, Industrial Research Centre and local authorities) through a guided interview. A questionnaire was also used to collect data from the quarry staff.

The use of a case study approach in this research allowed a thorough investigation of typical Libyan government organisations. The qualitative research strategy ensured that a representative cross section of the people who worked in the aggregates industry and the government organisations could be questioned in depth regarding their opinions about aggregate extraction and its environmental impacts. Quarry staff were given questionnaires to complete and their responses were cross-checked with the information provided by government organisation employees. All of these respondents supplied rich, in-depth information about the aggregates industry and its environmental impacts within the Libyan context.

Chapters Six, Seven and Eight reported on and discussed the findings of the empirical study. The fieldwork findings and the key issues of the industry were addressed in Chapter Six. The questionnaires and interview findings were presented and analysed in Chapter Seven. Thus, the key findings are summarised and discussed in Chapter Eight along with recommended guidelines to the Libyan government. Finally, this chapter provides the key conclusions and recommendations of the study.

9.3 Research Findings

From this research, it is clear that the environmental impacts of aggregate extraction are very serious in Libya and the environmental protection plan that attempts to control them is weak. The barriers facing the environmental protection plan's implementation can exist at individual, managerial, organisational, and national levels. This research has highlighted those environmental impacts and the barriers facing the implementation of the environmental protection plan, which appear when the aggregate industry and government organisations ignore the need for environmental protection, or simply believe that for them, it is not essential or relevant.

Based upon review and analysis of the data collected from the sources referred to earlier, the following major findings emerge:

1. There are large numbers of quarries working without permission.
2. The work permission can be obtained from different sources such as the local authority, county governments, Ministry of Industry and Ministry of Transportation.
3. The current permit/licence procedure is very weak and needs to be improved to comply with industrial development.
4. The environmental protection awareness in the aggregate companies and the government organisations is very weak.
5. There is no co-ordination or collaboration between the government organisations and the aggregate companies, in particular in the fields of environmental protection training and development and many other aspects of services. This lack of liaison between these two responsible bodies has an adverse impact on the quality of qualified personnel suitable to this most valuable Libyan industry.
6. There was no system which allowed the employees to make their own feelings about environmental impacts known or to report environmental impact incidents, in both the aggregates industry and in the government organisations.

7. Most respondents to questionnaires stated that their managers or supervisors were not capable of providing them with the skills and knowledge they need, with regard to environmental protection.

8. There is no master plan for environmental protection training and development in the country to be used as guidance when training policies are formulated.

9. There is a need for experienced people in the field of environmental protection training and development in all economic and industrial sectors in the country, and in the aggregates industry in particular.

10. Most aggregates companies do not require their new employees to receive orientation training before they start their duties, which suggest that these companies are unaware of the importance of environmental protection training and employees may not have sufficient experience to perform their duties in an environmentally acceptable way.

11. There are a lot of environmental impacts created by the aggregates industry, due to:
    - the poor condition of machines and equipment used.
    - placing the quarry near populated areas to meet the local demand.
    - primary aggregates are the only source of aggregates in Libya.

12. The aggregates industry and the government organisations do not follow the environmental laws and regulations.

13. There is misunderstanding of the importance of the EMS in the Libyan context in general and the case study organisations in particular.

14. Large numbers of quarry staff and government organisations' employees do not know the environmental laws and policies in relation to quarrying activity and that they are not of major concern to them.

15. The local authorities did not ask the quarry owners to produce an environmental protection plan or development proposal that includes the end-use of the quarry site before granting them permission.
16. The local authorities did not supply the quarry owners with the current environmental laws and regulations that apply to quarrying.
17. The local authorities did not visit the quarry sites for work inspection as required by the environmental laws and regulations.
18. The environmental institutions did not give any assistance or advice to the quarry owners in regard to environmental protection.
19. The environmental institutions did not visit the quarry sites for work inspection as required by the environmental laws and regulations.
20. The environmental institutions did not offer to the quarry owners any courses, seminars, leaflets etc... in relation to environmental protection.

In addition to these considerable problems there are social and cultural issues in Libya which have a detrimental effect on environmental protection and which help to explain many of the above findings.

9.4 Social and Cultural influences on Environmental Performance

The influence of tribe and family, and cultural influences, have created their own barriers to environmental performance in Libya in general and the aggregates industry in particular. The research has highlighted that social and economic factors can create barriers to environmental performance development in the aggregates industry. One obstacle to effective environmental performance development was employee absenteeism from work in order to attend social events and ceremonies that resulted from family and tribal connections. It was noted that a high percentage of absenteeism was recorded on Wednesdays and Thursdays, which are the days when wedding parties and other social events and ceremonies are held according to Libyan traditions. Such levels of absence cause delays in work and in some cases even prevent work from being completed, such as inspection visits to the quarry sites.

One of the most important findings of this research is that the social relationships, which exist between many workers in Libyan government organisations and workers in the aggregates industry, have contributed to the inappropriate selection of quarry sites, and also affect the process of obtaining permission, which is often obtained without completing all the necessary documents. This finding supports that of Agnaia (1996) who suggests that, in order to satisfy others or ease some procedures for themselves, people working in government organisations do not follow the rules and regulations of their organisations. Therefore, administrative mistakes and errors have increased, which has led to a delay in achieving the organisation's objectives.

As mentioned by a number of authors in the literature, the basic units of Libyan society are the extended family, the clan, the tribe and the village. Each of these plays a very important role in the individual and community's life and people's relationships with each other. What has been found from the research is that the individual has to obey, respect and preserve the rules and traditions of those social units. Moreover, factors of kinship, family ties and collective solidarity influence the selection of leaders in the society instead of practical or academic qualifications. The Libyan authorities have issued many laws and regulations and have set criteria of competence and academic qualifications. However, in practice some of these criteria may not be applied by the Libyan organisations due to social, cultural and general environmental differences that encourage selection of employees on the basis of personal relationships and kinship or tribe, as mentioned above, rather than efficiency and competence.

Government organisations' employees are influenced by society in many ways, for example implementing laws and regulations or developing new plans subject to the influence of family or tribe because the employees comply with what their families want them to do rather than doing their job properly. Additionally, during the visit to the case study organisations which are under government control, it was evident that employees did not bother whether their jobs were finished or not, and they were not overly concerned by the effects of their absences, as they did not perceive their futures to be connected with the future of the organisation. Therefore, it can be said that Libyan government organisations employees have more loyalty to their family and tribe than to their organisations.

The communication processes between the government organisations and the aggregates industry were very strongly influenced by the organisational culture. The presence of traditionally-managed government-controlled organisations in Libya as well as the influence of society and culture has led to the creation of an environment where employees have more loyalty to their family and tribe than their organisations. This is because the influence of tribe and family has an impact on the actual allocation of positions and opportunities and so in order to satisfy tribe and family some of the government organisations employees stopped visiting the quarry sites for work inspections or were reluctant to force these quarries to comply and follow the environmental laws and regulations.

From what has been mentioned above social and cultural influences play a major role in preventing the achievement of a good environmental performance in Libya in general and the aggregates industry in particular. Changing those cultural influences might not be possible, but preventing them from affecting environmental protection development may be possible. This could be achieved by taking these influences into consideration, when the Libyan Government implements environmental laws and regulations or develops new environmental protection plans to control the environmental issues in the industrial organisations in general and the aggregates industry in particular

9.5 Lessons to be learned from the UK

As stated in Chapter Three the UK regulatory regime controlling minerals working in the UK has been developed over many years to improve the environmental performance of the mineral industry and to ensure that minerals are extracted in environmentally acceptable way. Comparing the two regulatory regimes in both countries (UK and Libya) it has been found that due to cultural, educational and political difference it is not possible at present to use most of the UK experience to improve the Libyan context. However there are some practices from the UK regulatory regime that could be useful in Libya. These are:

1. Introducing a new requirement to review the old work permissions granted in the past or before the Law No 15 of 2003 (where modern conditions do not apply) and to bring these permissions up to date.

2. The local authorities should use the landbanks idea to secure a steady supply of aggregates in all Libyan regions and to overcome any shortage of aggregates by bringing these sites quickly into production.
3. The Libyan Government should produce regulation or guidance notes similar to the UK's MPG6, which attempts to *"provide advice to mineral planning authorities and the minerals industry on how to ensure an adequate and steady supply of aggregates to the construction industry, accounting for the balance of social, economic and environmental costs, through full consideration of all resources and the principles of sustainable development"*.

9.6 Achieving the Research Aim and Objectives

The aim and objectives of the research were to collect both primary and secondary data by conducting a review of the literature, and undertaking a piece of empirical work in Libya to collect information regarding the environmental impacts of the Libyan aggregates industry, as well as managerial and employee attitudes towards it. Additionally, documentary evidence was investigated and a case study of government organisations in Libya was carried out to identify and analyse the current environmental impact of the Libyan aggregates industry and the barriers facing the current regulatory regime to control them. After conducting a literature review and designing data collection methods the author conducted two pilot studies to identify problems with questions posed in semi-structured interviews with government organisation employees and in questionnaires to quarry staff.

The research findings have highlighted the shortcomings of environmental protection in the Libyan aggregates industry and enabled recommendations for improving the system to be made.

9.7 Significance of the study

The researcher has found that there is a shortage of studies concentrating on understanding the aggregates industry and its environmental impacts in Libya, Arabic countries and developing countries in general. This study is unique because there have been no published studies dealing in depth with the environmental impact of mineral extraction in Libya. Among all the published works and unpublished PhD studies, the author did not find any work on environmental impact in the Libyan Aggregate Industry. Thus, this study will be the first to deal with this particular subject and it is hoped that it will shed some light on a neglected yet important issue.

This study could be of great value to those responsible for planning and formulating environmental protection in the aggregates industry in Libya. It is of particular importance to the Secretariat of Planning, the Secretariat of Minerals and Industry, the Secretariat of Agriculture, the Water General Authority and the environmental institutions (EGA and IRC).

This thesis provides some practical suggestions and recommendations that contribute to existing knowledge within the context of Libya. Such research has never been conducted in a Libyan industrial organisation, and hence the study provides a unique insight into the environmental impact of aggregate extraction.

In summary, the study's main contributions are as follows:

- The first contribution of this study is that it filled a part of the gap in knowledge of Libyan and Arabic studies and it contributes to an understanding of Libya's difficulties in improving environmental protection in its main industry, the aggregates industry and its aspirations for better environmental protection programmes.
- The second contribution of this research is that there are limited studies on the environmental impacts of aggregates extraction in developing countries in general and within the Arab socialist context in particular. This study has provided empirical evidence of environmental impacts in a number of Libyan aggregates companies. The findings of the study contribute towards a better understanding of the environmental impacts of aggregates extraction.
- The third contribution of this research is that, although it has addressed particularly the problem of environmental impacts from aggregates extraction in Libya, it should have some significance for other developing countries in the region such as Tunisia, Egypt, Algeria and Morocco that may be interested in developing comprehensive and integrated environmental protection programmes in their aggregates industries.
- The fourth contribution is that the researcher has recommended proposals or guidelines to the industry and government organisations, which will help towards reducing the environmental impact of the aggregates industry. This should also have some significance for other major industries in Libya.
- The fifth contribution of this research is that the richness of the data collected in this study reflected the advantage of adopting the case study

method in conducting research. Moreover the case study approach allowed the researcher to interact with the quarry owners and the government organisations' employees. This has led to some recommendations being made to the quarry owners about how to improve the environmental conditions in their quarry and also some recommendations being given to the government organisations' employees to try to improve their organisations' roles.

- The sixth contribution is that the research has given an insight into Libya's unique organisational and cultural barriers facing the implementation of environmental laws and regulations. By identifying those barriers the Libyan government can take them into consideration when starting to implement the environmental laws and regulations from the beginning.

The originality of this research is that it is the first study to identify, analyse and understand the environmental impacts of the Libyan aggregates industry and the barriers facing the regulatory regime in controlling them.

This study has been successful in making a contribution to policy formulation and management. As stated earlier, the aggregate industry is very important to the development of the Libyan economy. As a result the research highlighted the current problems facing the aggregate industry in Libya and this will assist policy makers such as the government and its organisations (Secretary of Economy, Secretary of Planning, and Secretary Minerals and Industry) in developing economic and the environmental policies.

9.8 Critical Reflections on the Research Methodology

The study was carried out in three connected stages where a case study strategy was chosen, as the philosophy of this research was phenomenological. Firstly, an intensive literature review was conducted in order to understand the aggregates industry and its environmental impacts and also how these impacts can be mitigated. Secondly, an empirical study was undertaken in Libya to collect information regarding the environmental impacts of the Libyan aggregates industry, as well as managerial and employee attitudes towards it. Finally, documentary evidence was investigated and a case study of government organisations in Libya was conducted.

The main methods (interview, questionnaire and field observation), adopted in this research, made the researcher confident that the data collected was of high quality. The researcher decided to use a semi-structured interview technique as a main data-collection method. A questionnaire was also distributed to aggregates industry staff. The submission of the questionnaire was to investigate the employees attitudes towards the environmental impacts of the aggregates industry and to compare those attitudes with government organisations employees responses. The researcher developed the interview questions to cover the environmental impacts of the aggregates industry and all barriers facing the current regulatory regime in controlling them. The researcher used the documentation provided by the case study organisations and his own fieldwork observations to triangulate with the data collected from interviews and questionnaire responses. Semi-structured interviews with government organisation employees were conducted for an in-depth understanding of different barriers facing the current regulatory regime in controlling the environmental impacts of the Libyan aggregates industry. To get in-depth information and collect the required data, the researcher made the interviewee more comfortable and relaxed before conducting every interview by introducing the importance and the purpose of the research. To ensure validity and to enhance the reliability, the researcher used multiple sources of evidence when collecting data (triangulation method) to reduce the case study bias, by ensuring that each respondent has an adequate understanding of every question in order to avoid bias. Also the researcher has given a clear explanation of the research before the interviews to counteract any possible bias. From the government organisations employees the researcher gained in-depth understanding of the types of barriers in the case study organisations; which has faced them to achieve good environmental performance in the Libyan industry in general and the aggregates industry in particular. The content validity of interviews and questionnaire questions was achieved through discussion and review. Secondly the Arabic version of those questions was submitted to four Arabic and Libyan students for revising and strengthening the Arabic translation and finally they were piloted in the case study organisations.

The research methodology used a qualitative approach to gather in-depth data. The researcher used both secondary and primary data to allow triangulation and help gather more accurate, reliable and validated research results. The interviews with government organisations' employees provided in-depth information that was then compared with the data collected from the quarry staff questionnaires.

The main difficulty faced by the researcher in using the questionnaire survey was that the questionnaire had to be distributed in person; however, the researcher was merely acting as a postman. That is, in most of the cases, the questionnaire was handed out in the targeted companies and recollected at a later time. This approach was necessary for the following reasons:

1. It was not possible to conduct the questionnaire survey using postal questionnaires due to the unavailability of specific addresses in a large numbers of the aggregates companies; moreover the postal delivery system is not available in the greater part of the country.
2. Telephone communication is not available in every company in the aggregates industry; this made it impossible for the researcher to conduct the questionnaire survey by telephone.

As mentioned above, the researcher has used the semi-structured interview technique as a main data-collection method. Due to time limitations the researcher did not include interviews from the Ministry of Industry or the General Peoples Congress. Interviews from those specific places would help to explore the decision maker's point of view regarding environmental policy and its poor implementation.

9.9 Recommendations for Further Research

This research has not been entirely conclusive and has led to some unanswered questions relating to the environmental impacts of minerals extraction in Libya. Further study is therefore required to both extend this research and to help to improve environmental protection in Libya. In the light of opening up of the Libyan economy and increased foreign investment in the past few years, while this research has taken place, this author recommends that additional research within the Libyan public sector could be interesting, in order to identify what changes, if any, have occurred in these more open times, as more foreign companies are entering Libya. The effect that Western environmental management practices might have on Libyan organisations could be assessed to see if exposure to them is of benefit. Whilst the differences in organisational culture and management style, and the practice of human resource development might initially appear as a good thing, there is also the possibility that this exposure to Western capitalist values may equally have a detrimental effect on Libyan culture and Libyan society as a whole. Of course, a more optimistic view of their influence might be the eradication of barriers to environmental protection training and development entirely. Therefore, in conclusion to this study a number of future recommendations are presented below for possible research:

- A comprehensive study of the environmental impacts of other Libyan mining and petroleum sectors.
- The results and observations of this current study could be used as a base for further research on environmental management issues in Libyan companies using both the questionnaire and case study methods.
- This study should be replicated in other Middle East and North African countries (a single country or a comparison between two or more countries) to provide further insight on the affect of country-specific factors on the aggregates industry and its environmental impacts.
- Benchmarking research to compare environmental impacts and regulation implementation in the Libyan aggregates industry with a similar industry in

other Arabic or developing countries could be useful for the Libyan aggregates industry to learn from the experience of industries in other countries.

- Research in methods and techniques on how to overcome the barriers affecting environmental protection in all Libyan organisations.

Study the above research areas, will benefit environmental protection in Libya and will improve environmental performance in the Libyan industry.

References

Abuznaid, A. S. (1994) Islam and Management, *Proceedings of Arab Management Conference*, Bradford: University of Bradford, 5-7th July. PP 25-41.

Adam, F. and Healy, M. (2000) *A Practical Guide to Postgraduate Research in the Business Area*, Blackhall Publishing.

Aggregates Advisory Service (1999) *The Role of the Planning System in improving the efficient use of Aggregates- Policies and Plans*. Department of the Environment, Transport and the Regions Research Contract MP0623. [Online]. Last accessed on September 2005 at URL: http://www.p2pays.org/ref/17/16593.pdf.

Agnaia, A. A. (1996) *Management Training Development Within its Environment, the case study of Libya*, Unpublished Ph.D. Dissertation. Manchester University, UK.

ASTM (1980) *Designation: C 125-79a: Concrete and mineral aggregates*. American Society for Testing and Materials *Annual book of ASTM standards*. Especially standards, Part 14. Philadelphia, PA, pp 878.

ASTM (1994) *Designation: C 125-93: Standard Terminology Relating to Concrete and Concrete Aggregates.* American Society for Testing and Materials. Annual Book of ASTM Standards, Vol. 04.02.

ASTM (1995) *Designation: D 8-94: Standard Terminology Relating to Material for Road and Pavements*. American Society for Testing and Materials. Annual Book of ASTM Standards, Vol. 04.03

Amaratunga, D. Baldry, D. Sarshar, M. and Newton, R. (2002) Quantitative and Qualitative Research in the Built Environment: application of "mixed" research approach, *Work Study: A Journal of Productivity Science*, *51*(1), 17-31.

Ashton, P. J. (1999) Using environmental impact assessments to determine the consequences of mining activities and to highlight the costs of sustainable development. In: *Proceedings of the Conference on Environmental*

Management Systems in Mining, 11-13 October 1999, Kempton Park, South Africa. 12pp.

Ashton, P. J. (2001) Avoiding conflicts over Africa's water resources. *Ambio*, a *Journal of the Human Environment,* Vol 31, Issue 3. pp.236-242.

Aswathanarayana, U. (2003) *Mineral Resources Management and the Environment.* Wilco, Amersfoort, the Netherlands.

Barclay, E. (2004) Firm Scraps Superquarries Plans After 13 Years fight. *The Press and Journals,* Aberdeen, 3 April 2004.

Bell, J. (1999) *Doing Your Research Project*, 3rd Ed, Open University Press, Buckingham.

Beyh, S (2004) *Computer & Communication Engineering: internet protocol telephony in construction.* Unpublished Ph.D. Dissertation, University of Salford, 2004. UK.

BGS (2002a) *Construction minerals.* British Geological Survey, Nottingham.

BGS (2002b) *Construction minerals.* British Geological Survey, Nottingham.

BGS (2003) *Strategic Environmental Assessment (SEA) and future aggregate extraction: in the East Midlands Region.* BGS, Nottingham.

BGS (2004) *Industrial minerals: Issues for planning.* BGS commissioned Report CR/04/076N.202pp. [Online]. Last accessed on September 2005 at URL: http://www.mineralsuk.com/britmin/imp_summary.pdf.

BGS (2005a) *Construction Aggregate.* Mineral Planning factsheet was produced by the British Geological Survey for the Office of the Deputy Prime Minister as part of the research project ODPM-BGS Joint Minerals Programme [Online]. Last accessed on July 2006 at URL: http://www.mineralsuk.com/britmin/mpfaggregates.pdf.

BGS (2005b) *Resources: How are Aggregate processed.* Planning for Minerals. [Online]. Last accessed on December 2005 at URL: http://bgs.ac.uk/Planning4Minerals/Resources_20.htm.

Blaxter, L. Hughes, C. and Tight, M. (1996) *How to Research*, Open University Press, Buckingham.

Blunden, J. (1975) *The Mineral resources of Britain*, Hutchinson.

Bobrowsky, P. T. (1998) Aggregate resources in global perspective, in Bobrowsky, P. T., ed., *Aggregate resources – A global perspective*: A.A, Balkema, Rotterdam, Netherlands, pp. 1-6.

Brannick, T. and Roch, W. K. (1997) *Business Research Methods: Strategies, Techniques and Sources*, Oak Tree Press, Dublin.

Brian J. S. and Stephen C. P. (1987) *Physical Geology*. Wiley (March 1987)

Brink, A. B. Van Schalkwyk, A. Partridge, T.C. Midgley, D.C. Ball, J.M. and Geldenhuis, S. J. (1990) The changing impact of urbanization and mining on the geological environment. *South African Journal of Science*, **86**(7-10): 434-440.

British Standard Institution (1994) *6069-2: Characterisation of air quality, Glossary of terms*. London, British Standard Publishing Limited.

Brown, I. J. (1989) The Development of Mining Legislation in the UK - protection for the Owner, the Miner, and the Environment. In *Proceedings of the 2nd International Mining History Congress* - Sept. 1989 (Bochum: Deutches Bergbau Museum, 1989).

Bryman, A. (1988) *Quantity and Quality in Social Research*, Routledge Kegan Paul, London.

Bryman, A. (2001), *Social Research Methods*, Oxford University Press, Oxford.

Canter, L. W. (1996) *Environmental Impact Assessment*. Second Edition. New York: McGraw-Hill inc.

Carlson, G (2005) *Mineral exploration*. Earth Science Australia [Online]. Last accessed on September 2005 at URL: http://earthsci.org/mineral/mindep/depfile/explora.htm.

Casely D. and Lury, D. (1989) *Data Collection in Developing Countries*, 2nd, Ed., Clarendon Press, Oxford.

CGER (1999) *Hardrock Mining on Federal Lands*. Commission on Geosciences, Environment and Resources. National Academy Press, Washington, D.C. 1999.

Christie, T. Thompson, B. and Brathwaite, B. (2001) *Mineral Commodity Report 22 - Aggregates*. New Zealand Mining, Volume 30. December 2001.

Clifford, J. and Marcus G. E. (1986) Writing Culture, The Poetics and politics of Ethnography, Los Angeles, University of California, USA.

Collis, J. and Hussey, R. (2003) *Business Research (A practical guide for undergraduate and postgraduate students),* 2nd Ed, Palgrave Macmillian, Hampshire.

COMNAP (1999) *Environmental Impact Assessment in Antarctica*. Council of Managers of National Antarctic Programs 1999.

Conant, L. C. and Goudarzi, G. H. (1967) Stratigraphic and tectonic framework of Libya, *Am. Ass. Petrol. Geol., Bull.*, **51**, 719-730.

Coppin, N. (1989) Environmntal Assessment for Opencast Mining. *M&O Environment.* Vol. 3, No 3, pp 17-22.

Coppin, N. J. Montgomery, A. and Brignall, D. (1995) Dust sources and control- UK opencast coal sites, *Proceedings of the international symposium on Air Pollution by Particulates*, Prague 1995, PP 175-197.

Coventry, S. and Wilson, S. (2004) Thames Gateway Bridge, Environmental statement: Addendum 2 Main report. July 2004.

CPRE (1999) *Quarry Conflicts.* The Campaign to Protect Rural England Publication 1999.

Cuba, E. and Lincoln, Y. (1994) Competing Paradigms in Qualitative Research. In N. Denzin & Y. Lincoln (Eds.) *Handbook of Qualitative Research* (pp. 105-117). Newbury Park, CA: Sage Publications.

David R. W. and Thomas G. G. (1998) *Aggregates from Natural and Recycled Sources. Economic Assessments for Construction Applications—A Materials Flow Analysis.* U.S. GEOLOGICAL SURVEY CIRCULAR 1176. Denver, Colorado 1998.

Dayman C. and Hollowey I. (2002) *Qualitative Research Methods in Public Relations Marketing Communication*, Routledge, London.

Deeb M. J. (1982) *Libya Since the Revolution: Aspects of Social and Political Development*, Prager Publisher, New York.

Fuller, R. A. (2002) £58.6M Green-up Fund. *Journal of the Institution of Environmental Sciences.* Vol 11, No2, page 8-10.

Denzin, N. (1989) *The Research Act: A Theoretical Introduction to Sociological Methods.* (3rd -ed), Englewood Cliffs, NJ, Prentice- Hall.

Denzin, N. K. (2000) Aesthetics and the practices of qualitative inquiry. *Qualitative Inquiry*, *6*(2), 256-265.

DETR (1998) *The Environmental effects of production blasting from surface minerals workings*, London TSO.

DETR/Environment Agency (2004) Model Procedures for the Management of Contaminated Land. Research Report No. 11. Department of the Environment, Transport and the Regions, London.

DETR (2001) *Planning for the supply of Aggregates in England* - DETR Consultation Paper. Department of the Environment, Transport and the Regions. Cabinet Committee.

DOE (1975a) *Aggregates the Way Ahead*, Report of Advisory Committee on Aggregates. London, HMSO.

DOE (1975b) *Planning Control Over Mineral Working*, Report of the Committee under the Chairmanship of Sir Roger Stevens GCMG. HMSO.

DOE (1988) *General Considerations and the Development Plan System, Mineral Planning Guidance Note 1*. London, HMSO.

DOE (1989) *Guidelines for Aggregates provision in England and Wales, Mineral Planning Guidance Note 6*. London, HMSO.

DOE (1991a) *Mineral planning Guidance Note 8: Environmental Act "Review of Mineral Planning Permissions*, London, HMSO.

DOE (1991b) *Mineral planning Guidance Note 8: Planning and Compensation Act 1991: Interim Development Order Permission (IDOs)- Statutory Provisions and Procedures*, London, HMSO.

DOE (1991c) *Environmental Effects of Surface Mineral Workings*. London. HMSO.

DOE (1993a) *Mineral Planning Guidance Note 11: The Control of Noise at Surface Minerals Workings.* London. HMSO.

DOE (1993b) *Mineral Planning Guidance Note 11: Consultation Paper.* London. HMSO.

DOE (1994) *Guidelines for Aggregates provision in England, Mineral Planning Guidance Note 6*. London, HMSO.

DOE (1995) *Mineral planning Guidance Note 14: Environmental Act 1995 "Review of Mineral Planning Permissions*, London, HMSO.

Easterby-Smith, M. Thorpe, R. and Lowe, A. (1991) *Management Research: an Introduction*, Sage, London.

Easterby-Smith, M. Thorpe, R. and Lowe, A. (2002) *Management Research: an Introduction* (Second Edition) London, Sage.

EGA (2002) *The First National Report on The State of Environment*. Tripoli. The Environmental General Authority publication.

EGA (2004A) The Resolution No 4 in 2004 as Guidance Note for Aggregate Extraction. Tripoli. The Environmental General Authority publication (Translated from Arabic).

EGA (2004B) *The Environment*, Environmental Magazine special Edition. Tripoli. The Environmental General Authority publication (Translated from Arabic).

Elbah, S. (2002) An Evaluation of Environmental Impact Assessment within the Planning Process in Libya and the UK in Relation to Cement Manufacture. Unpublished MPhil thesis. Sheffield Hallam University.

Eisenhardt K. M. (1989) Building theories from case study research, *Academy of management Review*, Vol.14, No. 41, pp. 532-550.

Elfathaly, I. (1979) *Political Development and Bureaucracy in Libya*. 2nd edition, DC Health and Company, Toronto, Canada.

Farley, R. (1971) *Planning for Development in Libya*, 1st Ed, Parger, New York.

Fellows, R. and Liu, A. (1997) *Research Methods for Construction*. Blakewell Science, London.

Fisher W. B. (1995) Libya: Physical and Social Geography, *the Middle East and North Africa* 41- Edition, pp. 680 –717.

Flick U. (2002) *An Introduction to Qualitative Research*, 1st edition, SAGE Publications, London.

Fuggle, R. F. and Rabie, M. A. (1996) *Environmental Management in South Africa*. Juta & Co, Johannesburg. 823 pp.

Furman, E and Hilden, M (1997) *Guidelines for Environmental Impact Assessment (EIA) in the Arctic.* Sustainable Development and Utilization. Arctic Environment Protection Strategy 1997. Finnish Ministry of the Environment, Finland, 50pp.

Ghauri, P. Gronhaug, K. and Kristianslund, I. (1995) *Research Methods in Business Studies: a Practical Guide,* Prentice Hall, London.

Gosling, D. (1990) Exposing Some of the Myths about Opencasting- A Case Study. Mineral Planning. March 1990.

GPC (1982) *Law No7 of 1982 in regard to environmental protection.* Tripoli. General Peoples Committee special publication (Translated from Arabic).

GPC (2003) Law No15 of 2003 in protection and improving the environment. Sirt. General Peoples Committee special publication (Translated from Arabic).

Gummesson, E. (1999) *Qualitative Methods in Management Research,* Sage Publications, Incorporated.

Hearn, P. Jr. Hare, T. Schruben, P. Sherrill, D. LaMar, C. and Tsushima, P. (2001) *Global GIS Database: Digital Atlas of Africa*, USGS. Digital Data Series (DDS-62-B).

Hegmann, G. Cocklin, C. Creasey, R. Dupuis, S. Kennedy, A. Highley, D. E. Chapman, G. R. and Bonel, K. A. (2004) *The Economic Importance of Minerals to the UK.* BGS publication. 2004

Hora, Z. D. (1988) Sand and Gravel Study 1985 - Transportation Corridors and Populated Areas: *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1988-27.

Hora, Z. D. and Basham, F.C. (1980) Sand and Gravel Study 1980 - British Columbia Lower Mainland; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1980-10.

Horne. R (2004) *EIA Module*. Unit 6, Distance Learning Course. Environmental and Energy Masters Programs, Recourses Research Unit. Sheffield Hallam University.

Howard, Bob, and Cameron, Ian, (1998) Dust control: Best Practice Environmental Management in Mining, *Environment Australia*, 73 pp.

Howard L. Hartman, J. and Mutmansky, M. (2002) *Introductory Mining Engineering,* 2nd Edition. John Wiley& Sons Ltd., New York, NY (United States).

Hussey J. and Hussey R. (1997), *Business Research (A practical Guide for Undergraduate and Post Graduate Students),* Palgrave Publishers Ltd, Hampshire.

Integrated Publishing (2006) Chapter Five: Quarry Supervisor [Online]. Last accessed on September 2006 at URL: www.tpub.com

IRC (2003) *The Libyan Quarrying Industry Report.* Tripoli. Industrial Research Centre publication (Translated from Arabic).

Jaeger, A. and Kanungo, R (1990) *Management in Development Countries*. Roultledge.

Jankowicz, D. (2000) *Business Research Projects*, Business Press, London.

Kabbur, M. (1995) *Antecedents and Consequences of Role conflict and Role Ambiguity in Libya Industrial Firms*, Unpublished Ph.D. Dissertation, Cardiff Business School.

Kellett, J. E. (1995) The Elements of a Sustainable Aggregates Policy. *Journal of Environmental Planning and Management* Vol. 38 N0 4pp. 569-679.

King, N. (1994) *The Qualitative Research Interview. Qualitative Methods in Organizational Research*. C. Cassel and G. Symon. London, Sage Publications.

Kingsley, L. (1999) *Cumulative effects assessment practitioner's guide*. Prepared by AXYS Environmental Consulting and CEA Working Group for the Canadian Environmental Assessment Agency, Hull, QC, Canada.

Kuzu, C and Ergin, H. (2005) An assessment of environmental impacts of quarry-blasting operation: a case study in Istanbul, Turkey. *Environmental Geology* (2005) pp 211–217.

Lacy, W. (2003) *An Introduction To Geology And Hard Rock Mining. Science and Technology Series. Rocky Mountain Mineral Law Foundation* [Online]. Last accessed on September 2005 at URL: http://www.rmmlf.org/SciTech/Lacy/lacy.htm#VI.A.2

Langer, W. H. (1988) Natural aggregates of the conterminous United States: *U. S. Geological Survey Bulletin* 1594, 33 pp.

Langer W. H. and Daniel, H. K. (1995) *Geologic characterization of natural aggregate a field geologist's guide to natural aggregate resource assessment.* Open File Report 95-582. United States Geological Survey, United States Department of the Interior, Denver, Colorado. (969 Kb).

Langer, W. H. (2001) Environmental impacts of mining natural aggregate, *in* Bon, R.L., Riordan, R.F., Tripp, B.T., and Krukowski, S.T., eds., *Proceedings of the 35th Forum on the Geology of Industrial Minerals—The Intermountain West Forum*: Utah Geological Survey Miscellaneous Publication 01-2, p. 127-138.

Langer, W. H. Drew, L. J and Sachs, J. S (2004) Aggregate and the environment: *American Geological Institute Environmental Awareness Series* No. 8, 64 pp.

Leavy, B. (1994) The craft of Case-based Qualitative Research, *Irish Business and administrative Research,* Vol. 15, No. 4, pp. 105-118.

Libyan online (2002) *The Establishment of the Environmental organizations and associations by the Libyan community.* [online]. Last accessed on October 2004 at URL: www. Libyanonline.com. (Translated from Arabic).

Marotta, T. W. (2002) *Basic Construction Materials.* 6th Ed. Prentice Hall, New Jersey, 2002.

Marshall C. and Rossman G. (1999) *Designing Qualitative Research*, 3rd edition, SAGE Publications, London, UK.

Marusich, L. J. and Wilkinson, P.F. (2001) The Application of Fuzzy Logic Analysis to Assessing the Significance of Environmental Impacts: Case Studies from Mexico and Canada. *Research and Development Monograph Series*, 2001.

Masoud, M. Albadri, A. Karish, S. Alkailani, M. and Abbas, H (1998) *The Environmental Impact of Quarrying in Zintan City and its surrounding area.* Department of Geology, University of Al-Jabal Al-Gharbi (Translated from Arabic).

Masoud, M (2003) *Petrography and Diagenesis of the Mamuniyat Formation. Conssion NC115, Murzuq Basin SW Libya*, Unpublished MSc thesis. The University of Manchester.

Masoud, M. A. and Heath, M. J. (2006) The environmental impact of the aggregate quarrying in Libya. *Proceedings of the Intrnational Symposium, 2006. Environmental Issues of Mineral Industry.* PP 291-298. MINTECH Publications, India, 2006.

Maybe R. C. and Wood R. J. (1986) The future Demand of Welsh aggregates-Industry view. *Environmental research Group Seminar.* 18-19th April 1986. University of Wales Institute Science and technology Cardiff.

McLaughlin, J. (1993) MPG6 an industry View. RICS *Minerals Division Yorkshire Branch Seminar*, Wakefield.

McGuire, J. W. (1964) Theories of business behaviour, Englewood Cliffs, Pentice-Hall, *International series in management.*

Media Maps data (2007) Libyan Map. [online]. Last accessed on January 2007 at URL:http:\\media.maps.com/magellan/Images/LIBYA-W1.gif

Mellor, J. (1997) The Sustainable Use of Aggregates: Myth or Possibility? Bristol Friends of the Earth Publications [Online]. Last accessed on September 2005 at URL: http://www.joolz.demon.co.uk/campaigns/ashtonct/joolzmasters.html.

Miles, M. and Hubberman, M. (1994) *Qualitative Data Analysis*, 2nd edition, SAGE Publications, London, UK.

Ministry of Industry (1970) *Law No 79 of 1970 to reorganise the mineral industry.* Libyan Ministry of Industry special publication. (Translated from Arabic).

Ministry of Industry (1971) *Law No 2 of 1971 for quarrying and mining.* Libyan Ministry of Industry special publication. (Translated from Arabic).

Ministry of Industry (1973a) *Law No 8 of 1973 in respect to prevention of oil pollution to sea waters.* Libyan Ministry of Industry special publication. (Translated from Arabic).

Ministry of Industry (1973b) *Health law No 106 of 1973 and its executive regulation.* Libyan Ministry of Industry special publication. (Translated from Arabic).

Ministry of Industry (1984) The Libyan Mining and Quarry Procedures. Special Publication, 1984.

Morgan, P. G. (2003) Environmental Taxation of Surface Mining in the United Kingdom. *Car7.* Cepmlp, Dundee University.

Msalati, A (1995) The Geological and Tectonic setting of Libya. *In Jamahiriya, Studies in Geography by Abou Logma and Gzeree.* Jamahiriya Publishing house1995. pp 29-91 (Translated from Arabic).

Munn, R. E. (1979) *Environmental Impact Assessment, SCOPE 5*, Second Edition, The Scientific Committee on Problems of the Environment (SCOPE), Toronto, 1979.

Nachmais C. F. and Nachmais, D. (1996) *Research Methods in the Social Sciences.* 5th Edn. Arnold, London.

NAID (1995) *Census 1995*, Secretary of Planning, National Agency of Information and Documentation, Tripoli - Libya.

National Academy of Sciences (1980) *Surface mining of non-coal minerals* Appendix I - Sand and gravel mining, and quarrying and blasting for crushed stone and other construction minerals: National Academy of Sciences, Washington, D.C., 91 pp.

Nauar, I. (1997) *Sanction and Development: The Effect of the Economic Sanctions on the Development of Libya, Iraq and Sudan Strategic Draft (60)*, produced by the Centre of Strategic Studies on Aharam, Egypt (7), 1997 page 39.

Naur, M. (1986) *Political Mobilisation and Industry in Libya*, Akademisk Forlag, Denmark.

NCGS (2005) Crushed stone (aggregate) overview. *North Carolina Geological Survey Publications* [Online]. Last accessed on September 2005 at URL: http://www.geology.enr.state.nc.us/NAE%20aggregates%20Internet%20NRC%20with%20USGS%20sheet/Aggregate%20overview%20new.htm#crushed.

Nicholson, D. T. (1995) The Visual Impact of Quarry; *in Quarry Management*, 22 (7), pp 39-42.

Nicholson, D. T. (1996) The Visual Impact of Quarrying. *Rock Products 99*, 2, pp 68-76.

Norman, C. (2001) a Difficult Balancing Act- The Significance of Public Perception in Determining a Mineral Planning Application. *Quarry Management*, Vol. 28, No 11, pp 41-45.

NRCA (1997) *Guidelines for Conducting Environmental Impact*. Natural Recourses Conservation Authority. July 1997.

NSC (2004) *The Educational Use of Aggregate Sites*. National Stone Centre [online]. Last accessed on October 2004 at URL: http://www.nationalstonecentre.org.uk/euas/industry/quarrying.htm

ODPM (2003) *The apportionment of Regional Guidelines for Aggregate Provision in England (2001-2016).* ODPM.

Oldershaw, C. (2003) The *Earth in our hands report 11(Aggregates).* The Geological Society London.

Oppenheim, A. N. (1992) *Questions and Attitudes*, Pinter, London and New York.

OST (2003) Foresight Flood and Coastal Defence Project (Working Paper). Phase 1 Technical Report, Drivers, scenarios and work plan. Office of Science and Technology, 2003.

Pollock, A, Kirk, D and Associates (2002) *Review of Old Mineral Permissions.* Scottish Executive Central Research Unit.

PQU (2002) Mining Industry an overview. *Quarryology 101*. Pit & Quarry University, US.

Quarry Products Association (2006) The Virtual Quarry [Online]. Last accessed on September 2006 at URL: http://www.virtualquarry.co.uk/

Quin, R. (1961) *Libya: Brief Political and Economic Survey*, Royal Institution of International Affairs, Oxford.

Raynsford, N. (1997) House of Common Meetting "Longstone Edge, 3rd December 1997". House of Common [online]. Last accessed on July 2005 at URL: www.parliament.the-stationery-office.co.uk/pa/cm/cmhansrd.htm.

Remenyi, D. Williams, B. Money, A. and Swartz, E. (1998) *Doing Research in Business and Management: An Introduction to Process and Method*, Sage Publications, Newbury.

Ricketts, M. J. (2001) *Granular Aggregate Mapping in NTS Map Areas 1N/2, 1N/11, 11O/14 and 11O/15.* Current Research (2001) Newfoundland Department of Mines and Energy Geological Survey, Report 2001-1, pp 279-291.

Richard, C. (2002) Layers: an on-going investigation into areas of the Sussex landscape, that reveal layers of history, both Geological and man-made [Online]. Last accessed on July 2006 at URL: www.free range.org.uk/images/images/23390.jpg.

Rossouw, N. (2003) A Review of Methods and Generic Criteria for Determining Impact Significance. *Ajeam-Ragee.* Vol6, pp 44-61.

Sapsford, R. (1999) *Survey Research*, Sage, London.

Saunders, M. Lewis, P. and Thornhill, A. (2000) *Methods for Business Students,* 2nd edition, Pearson Education Limited, London.

Saunders, M. Lewis, P. and Thorn hill, A. (2003) *Research Methods for Business Students,* 3rd Edition, Pearson Education Limited, London.

Scott, P. W. (2004) The real mineral resources of the United Kingdom. *Humberside Geologist no 14.* Camborne School of Mines, University of Exeter.

Secretariat of Libyan Planning (1995) *Report of International labour Office on Personnel Management*, Tripoli, Libya, (Arabic Language).

SOU (1981) *Tripoli Subregion, Development Plans 2000, report No TF-20.* Secretariat of Utilities, *By Polservice. Consulted office. Warsaw. Poland.*

SOU (1985) *National Physical Perspective plan 1982-2000.* Secretariat of Utilities, *by HABITAT.* Tripoli.

Sekaran, U. (2003) *Research Methods for Business a Skill-Building Approach,* Fourth Edition, John Wiley and Sons, Inc., New York.

Severn Estuary Partnership (1997) *Severn Estuary Joint Issues Report: Aggregates and other minerals.* Environment Agency & University of Wales, Cardiff.

Shopley J. B. and Fuggle R. F. (1984) A comprehensive review of current Environmental Impact Assessment methods and techniques. *Journal of Environmental Management,* 1984;18, pp 25-47.

Smith, M. R. and Collis, L. (2001) *Aggregate: Sand, Gravel and Crushed Rock aggregates for construction purposes.* Geological Society, London, Engineering Geology Special Publacation, **17**.

Solar, V. S. (2002) Environmental impacts of quarrying similarities to and differences from other mining Slovenian case. In Erik, P., Luca, M and Marco D.A: *Workshop on Mine and Quarry Waste-the Burden from the Past*. 27th-28th May 2002. Orta, Italy. pp 43-45.

Stake, R. E (1995) *The Art of Case Study Research*, Sage Publications, London.

Stevenson, T (2004) *Dust Suppression on Wyoming's Coal Mine Haul Roads.* Dust Suppressant Selection Guides. [Online].last accessed on September 2005 at URL: http://www.oznet.ksu.edu/Stevenson/Dust%20Manual%20%20102704.pdf

Strauss, A. and Corbin, J. (1990) *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*, Sage Publications, Newbury.

Suter, A. H. (1991) Noise and Its Effects. *Administrative Conference of the United States.* The Noise Pollution Clearinghouse Online Library. US, November 1991.

The British Council (1998) *The UK environmental Industry*. Briefing Sheet 17.

The Environment Agency (2003) *Monitoring of Particulate Matter in Ambient Air around Waste Facilities: Technical Guidance Document (Monitoring) M17,* Environment Agency, London.

The Environmental Agency (2004) *Guidance on Assessment of Risks from landfill.* Environment Agency, Rio House, may 2004.

The Environment Agency (2006) *General water issues for the Mining & Quarrying sector.* [Online]. Last accessed on September 2005 at URL: http://www.netregs.gov.uk/netregs/processes/677873/?version=1&lang=_e.

The European Commission (1996) *Green Paper on Future Noise Policy, Directorate General for Environment,* Nuclear Safety and Civil Protection, Brussels. Office for Official Publications of the European Communities.

The European Commission (2000) *White Paper on Environmental liability*. European Communities. Luxembourg, Office for Official Publications of the European Communities.

TCEP (1992) *Weather and Climate*. The Technical Centre for Environmental Protection. Tripoli (Translated from Arabic).

Thomas, D. (1986) The future demand of Welsh aggregates- Industry view. *Environmental Research Group Seminar*. 18-19th April 1986. University of Wales Institute Science and Technology Cardiff.

Thompson, M. A. (1990) Determining impact significance in EIA: a review of 24 methodologies. *Journal of Environmental Management*, 1990; 30, pp 235-250.

US, Department of the Interior (2005a) *Dictionary of Mining, Mineral, and Related Terms.* US Bureau of Mines. [Online]. Last accessed on December 2005 at URL: http://www.maden.hacettepe.edu.tr/dmmrt/.

US, Department of the Interior (2005b) *Minerals Exploration, Development and Production*. Bureau of Land Management. [Online]. Last accessed on September 2005 at URL: http://www.blm.gov/utah/monticello/MEDP.pdf.

US, Department of Labour (2005) *Career Guide to Industries/* Mining. Bureau of Labour Statistics [Online]. Last accessed on *November 23, 2006 at URL*: http://www.bls.gov/oco/cg/cgs004.htm.

Van Maanen, J. (1979) The self, the situation, and the rules of interpersonal relations, in W. Bennis, J. Van Maanen, E. H. Schein and F. Steele (eds), *Essays in International Dynamics*, Homewood, IL: Dorsey.

Walters, M. (1996) *Employee Attitude and Opinion Surveys*, Institute of Personnel Development. London

Wilburn, D. R. and Goonan, T. G. (1998) Aggregates from Natural and Recycled Sources: Economic Assessments for Construction Applications-- A

Materials Flow Analysis. *U.S. Geological Survey Circular 1176* [Online]. Last accessed on September 2005 at URL: http://www.p2pays.org/ref/04/03217.pdf

Williams, M. (2003) *Making Sense of Social Research*, SAGE Publications, London.

Wrap (2006) *More Information on Recycled and Secondary Aggregates*. Waste and Resources Action Programme [Online]. Last accessed on July 2006 at URL: http://www.aggregain.org.uk/more_information.html

Wright, A. D. (2004) *Marine Aggregates*. [Online]. Last accessed on April 2004 at URL: www.parliament.the-stationery-office.co.uk .

Yin, R. K. (1989) Case study research-Design and methods. *Applied Social Research Methods series*, Vol.5, Sage, pp78.

Yin, R. K. (1989) *Case study research: Design and methods*. Newbury Park, CA: Sage.

Yin, R. K. (1994) *Case Study Research: Design and Methods*, 2nd Ed, Sage, Beverly Hills.

Yin, R. K. (2003) *Case Study Research: Design and Methods*, 3rd Ed, Sage Publications, London.

Zickmund, W. G. (2000) *Business Research Methods*, 6th Ed, the Dryden Press, Harcourt College Publisher.

Appendix (1)

Statistical Tables

No	**County name**	***Gravel and Crushed rock quarries***	***Sand quarries***	***Building stone quarries***
1	**Azawia**	**-**	**-**	**53**
2	**Sabratah & Surman**	**-**	**-**	**32**
3	**Ghadamis**	**32**	**-**	**-**
4	**Nalut**	**1**	**5**	**-**
5	**Yafran**	**24**	**9**	**-**
6	**Mizdah**	**1**	**-**	**2 Marble**
7	**Al-Betnan**	**11**	**1**	**-**
8	**Gharyan**	**17**	**5**	**-**
9	**Ajefarh**	**17**	**-**	**-**
10	**Tajora & Al-Nuahee Alarbaa**	**23**	***-***	***-***
11	**Al-Margb**	**13**	**1**	**1**
12	**Tarhunah & Amslath**	**18**	**1**	**-**
13	**Bani walid**	**4**	**-**	**-**
14	**Misratah**	**22**	**-**	**2**
15	**Surt**	**9**	**-**	**-**
16	**Aljufra**	**7**	**-**	**-**
17	**Sabha**	**8**	**-**	**-**
18	**Wadi Al-Shate**	**5**	**-**	**-**
19	**Wadi Al-Haya**	**4**	**-**	**-**
20	**Ajdabiya**	**6**	**-**	**15**
21	**Alhezam Alakdar**	**11**	**-**	**-**
22	**Aljabal Alakdar**	**4**	**2**	**3**
23	**Algubah**	**10**	**1**	**-**
24	**Darnah**	**6**	**2**	**-**
25	**Ghat**	**1**	**-**	**-**
26	**Al-Marj**	**6**	**2**	**-**
27	**Murzuq**	**4**	**-**	**-**
	Total	**264**	**29**	**118**

Table 2.4 Distribution of Quarries by County

Year	Gravel and Crushed Rock	Sand	Gypsum	Mud	Total
1991	27620	4023	1060	11570	44273
1997	41560	4640	1056	11867	59123
2003	53508.1	7679	1230	12320	74737

Table 2.5 Showing Aggregate Production in the Past 15 years (IRC, 2003)

Quarries Distribution	Number	Production in One Quarry in m^3	Production in all Quarries in m^3
Small companies (Al-Tashrokiat)	127	107.3	13627.1
National companies	61	315.4	19239.4
International companies	76	271.6	20641.6
Total	264		53508.1

(m^3= Cubic Meter)

Table 2.6 The Daily Production of Gravel And Crushed Rock in Cubic Meters (IRC, 2003).

Quarries Distribution	Number	Production in One Quarry in m^3	Production in all Quarries in m^3
Small companies (Al-Tashrokiat)	12	130	1560
National companies	7	297	2079
International companies	4	1010	4040
Total	23		7679

(m^3= Cubic Meter)

Table 2.7 The Daily Production of Sand in Cubic Meter (IRC, 2003).

Chapter Six Tables:

Year	Quarries number	Sand	Building stone	Crushed rock and gravel	Total of employees
1991	273	21	45	207	4254
1997	292	21	56	215	4522
2003	411	29	118	264	8580

Table 6.3 Showing the increase in the number of quarries in the past 15 years (IRC, 2004).

Appendix (2)

Government Organisations Employees
Interview Questions

Interview

Dear Sir/Madam

Peace and God's blessings be upon you,

The researcher is undertaking a study on the environmental impact of aggregate quarrying in Libya for PhD research degree at Sheffield Hallam University in the UK.

As a part of the research, the enclosed interview is attended to collect some necessary information about the environmental impact of aggregate quarrying in Libya. The main aim of this study is to investigate the environmental impact from aggregate extraction in the Libyan aggregate industry and develop proposals for an appropriate regulatory regime to control them.

Therefore, kindly answer this questionnaire as you deem appropriate. It highly noted that all information, data and details you will give here will be treated as confidential and used for scientific purpose only.

The researcher believes that your wide experience is significant to the outcome of this research study.

Thank you in advance for your interest, contribution and cooperation.

Best regards,

Researcher

Mohamed A. Masoud

Please tick (√) and fill in the spaces wherever appropriate

A: General information about the interviewees

- Name (optional)...

    Organisation:...

    Address:...

    Tel:... Email:...................................

- Sex ☐ Male ☐ Female ☐
- Age Less than 20 ☐ 20-30 ☐ 31-40 ☐ 41-50 ☐ over 50 ☐
- Education level:

    a- basic Literac☐ b- Primary school ☐

    c- Intermediate stage ☐ d- Secondary stage☐

    e- University stage ☐ f- Post graduate ☐

    g-Other ☐ please specify:..

- Job details ....
- Years of experience .... years
- Interview time: at............ on........... / / 2004

B: Quarry Operation Permission

1- Is your organisation included in the permit/ license procedure of opening quarry?
Yes ☐ No ☐ Don't know ☐

2- If yes to question 1 what your organisation responsible for:
a- Work inspectors to stop the quarry operation from generating environmental impacts. ☐
b- Implementing the laws and regulations and force people to follow them ☐
c- Issuing the environmental permission. ☐
d- Study the EIA reports before granting the permission. ☐
e- Issuing the work permission ☐

3- Is the budget, allocated to your organisation sufficient to meet your organisation goal in the planning system?
Yes ☐ No ☐ Don't know ☐

4- Do you think that the current permit/ license procedure adequate?
Yes ☐ No ☐ Don't know ☐

5- If no to question 5, which of the following is the main reason for your dissatisfaction?
   a- There is no communication or sharing of ideas between the government organisations in terms of permission, experience, control of aggregate extraction and implementing of environmental laws and regulations. ☐
   b- There is more than one organisation who granted working permission. ☐
   c- Limitation of fund in some of the organisations. ☐
   d- The local authorities did not help other organisation to do their work properly. ☐
   e- There is no one is responsible for monitoring the permission and to force the aggregate company to renew their permission ☐

6- Do you think the following suggestion can improve the current procedure?

	Suggestions	Yes	No
A	submitting the (EIA) report to any new quarry before getting the permission		
B	Introducing a system which can be used to link all government organisations to stop misfeasance of granting permission.		
C	The permission must have limited time.		
D	The government must provide sufficient budget to the organisations to do the work properly.		
E	All the government organisations must have highly qualified staff		
F	Provide money as a guarantee for site restoration.		

7- Are you aware that there are large numbers of quarry operating with expired or simply without permit/ license?
   Yes ☐ No ☐ Don't know ☐

8- If yes to question 9 do you think this is due to (tick as many as you think):
   a- Lack or poor implantation of laws and regulations ☐
   b- Lack/Absence of local authority role ☐
   c- Lack of qualified staff in the County (Al-Shabiat) government ☐
   d- Lack of experts in the Ministry (Popular committee) of Industry ☐
   e- Others, please specify what? --

9- Does your organisation have any authority to stop, control and monitor operations?
   Yes ☐ No ☐ Don't know ☐

10- If yes to question 10 which if the following your organisation can do to control and monitor operations?
   a- Produce a resolution to close any quarry making environmental impact ☐
   b- Do not give an environmental permission to any quarry works without permission ☐
   c- Non-renewal of the ended licences ☐

d- Ask the agriculture police to close bad quarry ☐
e- Implementing the laws and regulations and force people to follow them ☐

B: Environmental Impact

11-Are you and your organisation aware of the importance of the environmental protection?
Yes ☐ No ☐ Don't know ☐

12-What is your organisation's main role in the environmental protection form the following:
a- Produce annual reports about all industrial projects make environmental impact. ☐
b- Penalises any project making environmental impact. ☐
c- Control of products such as aggregates products and making sure that the product in high quality and much the typical specification. ☐
d- Making sure that the environmental laws and regulations are fully implemented and cover all source of development. ☐
e-Others: .... ☐

13-Do you think the following reasons are the main reasons of the current environmental impacts in the aggregate industry?

	Reasons	SD	D	UD	A	SA
A	The primary aggregates is the only source of aggregates used by the industry					
B	The organisations monitoring and controlling the quarrying industry are incapable to stop its environmental impacts					
C	The organisations monitoring and controlling the quarrying industry are incapable to stop its environmental impacts					
D	Placing the quarry near the populated areas to meet the local demand					
E	Bad conditions of machines and equipments used to produce the aggregate					
F	most of the quarry making environmental impacts belong to micro or family company which has financial difficulty to implement the environmental laws and regulations					
G	The Libyan government did not give loans or help to produce an alternative aggregates products					

14-Do you think the following suggestions can improve the impact of quarrying activity?

	Reasons	SD	D	UD	A	SA
A	There must be an environmental impact assessment report to any new quarry					
B	The permission procedure system must follow the environmental laws and regulations also the guidance notes provided by the EGA					
C	The quarry land must be industrial land and agreed by the Ministry of					

	Industry						
D	The government must encourage companies to use the secondary aggregates and help them to produce more alternative products						
E	The equipment used to produce aggregates must be compatible with the environmental standards						

15-Do you get any complained from the neighbouring residence or land owners?

Yes ☐ No ☐ Don't know ☐

16-If yes to question 6 is there concern about:

a- Dust and noise ☐
b- Blasting (vibration and air overpressure) ☐
c- Ground and surface water ☐
d- Traffic ☐
e- Visual impacts ☐

C: Environmental Laws and Regulations

17-Is your organisation aware of the importance of the Laws and Regulations?

Yes ☐ No ☐ Don't know ☐

18- If yes to Question 17 do you follow the environmental laws and regulations?

Yes ☐ No ☐ Don't know ☐

19-Is your organisation involved in the implementation of the environmental Laws and Regulations?

Yes ☐ No ☐ Don't know ☐

20-If yes to question 18 which if the following are the main obstacles facing the implementation of the environmental Laws and Regulations in the Libyan Aggregate Industry?

a- Conflict between the organisations in granting permission ☐
b- Disregard from the local authorities to implement the laws and regulations ☐
c- Shortage of qualified staff to implement the laws and regulations. ☐
d- Disregard of the EGA role from other government organisations. ☐
e- Financial difficulty in some of aggregate company ☐
f- Others: .... ☐

21-Are you aware of current environmental Laws and Regulations that applies to quarrying?

Yes ☐ No ☐ Don't know ☐

22-Do you assist the quarry owners with the latest environmental Laws and Regulations which applies to them?

Yes ☐ No ☐ Don't know ☐

D: The role of local authorities (to be answered by local authority's staff only)

23- Do you know that the local authority has the statutory powers pertaining to planning, development and management of environmental protection?
Yes ☐ No ☐ Don't know ☐

24-Is the local authority has power to control and monitor quarrying impact?
Yes ☐ No ☐ Don't know ☐

25-If yes to question 24 which of following can the local authority do to control and monitor quarrying impact?
a- Stop granting work permission. ☐
b- Making sure that the finished sites is fully restored as planned by the relevant departments. ☐
c- Close any site making environmental impacts. ☐
d- Others: .... ☐

26-Based on your experience and knowledge do you agree with the current role of the local authority?
Agree ☐ Disagree ☐ Don't know ☐

27-Do you ask the quarry owners to produce environmental protection plan before granting them permission?
Yes ☐ No ☐ Don't know ☐

28-Do you ask the quarry owners to produce the development proposal that includes the end-use of the quarry site?
Yes ☐ No ☐ Don't know ☐

29-Do you supply the quarry owners with the current environmental Laws and Regulations that applies to quarrying?
Yes ☐ No ☐ Don't know ☐

30-Do you regularly visit the quarry sites for work inspection?
Yes ☐ No ☐ Don't know ☐

31-If yes how regular is it?
a- Weekly ☐ b- monthly ☐ c- every 6 months ☐ d- yearly ☐
e- Others:..............................

32-Do you think the following suggestions can improve your organisation role in the planning system:

	Reasons	SD	D	UD	A	SA
A	Stop granting permission to any quarry without completing all the necessary documents					
B	The local authority must prepare specialised technical cadres to monitor the aggregate industry					

C	The local authority must give more roles to the environmental institutions					
D	Activate the environmental laws and the regulations and force the aggregate industry and the government organisations to follow them.					
E	The local authority must make sure that the equipments used to produce aggregates compatible with the environmental standards					

E: The environmental institution role

33-Does your organisation have any branch/office outside the headquarters?

Yes ☐ No ☐ Don't know ☐

34-If yes, to question 1 do you think those offices will help your organisation to improve its role in the planning system?

Yes ☐ No ☐ Don't know ☐

35-If no, to question 1 do you think this lack of offices affect your organisation role in the planning system?

Yes ☐ No ☐ Don't know ☐

36-Does your organisation give any assistance or advice to the quarry owner in regards to the environmental protection?

Yes ☐ No ☐ Don't know ☐

37-Do you think the following reason is the main reason for your organisation to do not assist the quarry owners in regards to the environmental protection according to its established law?

	Reasons	Yes	No
A	Large numbers of the quarry owner's work without environmental permission.		
B	The local authority did not help the environmental institutions to play its part in the environmental protection scheme.		
C	Lack of budget allocated to the environmental institutions.		

38-Does your organisation regularly visit the quarry sites for work inspection?

Yes ☐ No ☐ Don't know ☐

39-If yes how regular is it?

a- Weekly☐ b- monthly ☐ c- every 6 months ☐ d- yearly ☐

e- Others:..............................

40-Is your institution offered the quarry owners courses, seminars, leaflets etc… in relation to environmental protection?

Yes ☐ No ☐ Don't know ☐

41-Which of the following difficulties has faced your organisation to do its ideal role according to its establishment law and acts?

Difficulties	Yes	No

A	Lack of cooperation from other government organisations		
B	Shortage of equipments and qualified staff to do the work		
C	Lacking in some of the environmental laws and conflicts of roles and responsibility between the government organisations		
D	Activate the environmental laws and the regulations and force the aggregate industry and the government organisations to follow them.		
E	Lack of understanding to the IRC role in the planning systems from all government organisations.		

42-In terms of improving the environmental protection, which of the following suggestions could improve your organisation role in the planning system:

	Reasons	SD	D	UD	A	SA
A	The environmental organisations must Ask for the environmental impact assessment report to any new project before granting permission					
B	The local authority must prepare specialised technical cadres to monitor the aggregate industry					
C	Use public media such as TV and newspapers to educate people of the importance of the environmental protection					
D	The environmental institutions must prepare courses and seminars to the aggregate industry and the government organisations staff					
E	The environmental institutions must ask for more money from the government to do its part comprehensively					

F: If you have any other additional comments and suggestions, please state them

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Appendix (3)

Quarry Staff Questionnaire

Sheffield Hallam University

Questionnaire

Dear quarry operator

Peace and God's blessings be upon you,

The researcher is undertaking a study on the environmental impact of aggregate quarrying in Libya for PhD research degree at Sheffield Hallam University in the UK.

As part of the research, the enclosed questionnaire intends to collect some relevant information about the environmental impact of aggregate quarrying in Libya. The main aim of this study is to investigate the environmental impact from aggregate extraction in the Libyan aggregate industry and develop proposals for an appropriate regulatory regime to control them.

Therefore, kindly answer this questionnaire as you deem appropriate. It highly noted that all information, data and details you will give here will be treated as confidential and used for scientific purpose only.

The researcher believes that your wide experience is significant to the outcome of this research study.

Thanking you in advance for your interest, contribution and cooperation.

Best regards,

Researcher

Mohamed A. Masoud

Please tick (√) and fill in the spaces wherever appropriate

A: General information about the quarry operator

1-Name of respondent:...

Address:...

Tel:.. Email:...................................

2- Gender Male ☐ Female ☐

2- Age Less than 20 ☐ 20-30 ☐ 31-40 ☐ 41-50 ☐ over 50 ☐

4- Education level:

a- basic Literacy ☐ b- Primary school ☐

c- Intermediate stage ☐ d- Secondary stage ☐

e- University stage ☐ f- Post graduate ☐

g-Other ☐ please specify:...

5- With regard to the ownership of your quarry, what is it:

a- Small company (Al-Tashrokiat) ☐ b-National company ☐

c-International company ☐ d-Other ☐ please specify:.......................

6- What level are you in the quarry:

a- Quarry Manager ☐ b- Supervisor ☐ c- Administrator ☐

d- General employee ☐

B: Quarry Operation Permission

1- Do you have a permit/ license to operate this quarry?
Yes ☐ No ☐ Don't know ☐

2- If no to question1 did you have permit/ license before?
Yes ☐ No ☐ Don't know ☐

3- If yes to question2 which if the following reason make you to stop renewing your permit/ license?
a- Large number of quarries working without licence and the local authority did not force them to have licence ☐
b- The absence of the environmental institution roles ☐
c- other: .... ☐

4- If yes to question 1 state the duration of permit/licence:
Less than 1 year ☐ 1-5 years ☐ 6-10 years ☐

More than 10 years ☐

5- Which authority issued the permit/licence:
   a- Local authority ☐ b- County (Al-Shabiat) Government ☐
   c- Ministry (Popular committee) of Industry ☐
   d- Other☐ please specify ……………………………………………………

B: Environmental Impact

6- Are you aware of the importance of the environmental protection?
   Yes ☐ No ☐ Don't know ☐

7- If no to question1 is it because of:

	Reasons	Yes	No
A	there is no environmental department in your quarry		
B	lack of communication between them and their supervisors and managers in environmental matters		
C	the local authority and environmental institutions gave no opportunity to the quarry staff to attend courses or workshops to improve their skills in the field of environmental protection		

8- If yes to question1 did you get your knowledge from;
   a- Attending course, seminars etc… ☐
   b- TV and media ☐
   c- other: ………………………………………… ☐

9- Is there assigned personal in your company who is responsible for environmental protection matter?
   Yes ☐ No ☐ Don't know ☐

10-If yes to question 4, what is the post called?
   ……………………………………………………………………………
   ……………………………………………………………………………
   ……………………………………………………………………………

11-Do you feel that environmental protection measures are important?
   Yes ☐ No ☐ Don't know ☐

12-Is there any system introduced by which you can make reports on your environmental impact?
   Yes ☐ No ☐ I do not know ☐

13-Is there any environmental protection training for the employees that has been taken place in the past year?
   Yes ☐ No Don't know

14-Do you think the operation of your quarry detrimental/affect the quality of the environment?
   Yes ☐ No ☐ Don't know ☐

15-If yes to question 14, what are the main reasons of the current environmental impacts?

16-If yes to question 14 have you attempted to take any measures to reduce the impact?

Yes ☐ No ☐ Don't know ☐

17-If yes to question 16, which of the following did you use:

a- Water to reduce dust ☐
b- Avoid use of blasting ☐
c- Secure the site by trees or mound ☐
d- Reduce the working hours 7am -18pm ☐
e- Use good quality equipment to reduce noise ☐
f- other: .... ☐

18-Do you get any complaint from neighbouring residents or land owners?

Yes ☐ No ☐ Don't know ☐

19- If yes to question 18, is their main concern about?

	Suggestions	Yes	No
A	Dust		
B	Noise		
C	Blasting		
D	Visual impact		
E	Impact to ground and surface water such as see water intrusion, oil and fuel spills		

C: Environmental Laws and Regulations

20-Are you aware of the importance of the Environmental Laws and Regulations?

Yes ☐ No ☐ Don't know ☐

21-If yes to question 1 do you abide to the enacted Laws and stated policies?

Yes ☐ No ☐ Don't know ☐

22-Are you aware of the current environmental law and policies in relation to quarrying activity?

Yes ☐ No ☐ Don't know ☐

23-Does your company have any stated environmental management policy, objective and procedure?

Yes ☐ No ☐ Don't know ☐

24-If no to question 22 why you did not implement EMS is it because of:

	Suggestions	Yes	No
A	Lack of internal management support;		
B	The lack of environmental sound suppliers;		

C	High implementation cost;		
D	Lack of government pressure or support;		
E	Lack of expressed interest or training to staff.		

D: The role of local authorities

25-Does your local authority require you to produce environmental protection plan to your project before granting you permission?

Yes ☐ No ☐ Don't know ☐

26-If yes to question 5 which if the following did you supply:

- a- Environmental permission ☐
- b- Agriculture permission ☐
- c- EIA report ☐
- d- Site rehabilitation plan ☐
- f- other: ....

27-Does your local authority require you to produce the development proposal that includes the end-use of the quarry site?

Yes ☐ No ☐ Don't know ☐

28-Does your local authority provide you with the current environmental legislation that applies to quarrying?

Yes ☐ No ☐ Don't know ☐

29-Do you receive regular visits from the local authority for work inspection?

Yes ☐ No ☐ Don't know ☐

30-If yes is it?

a- Weekly☐ b- monthly ☐ c- every 6 months ☐ d- yearly ☐

e- Others:..............................

31-Which of the following factors can improve you local authority role and responsibility?

	Suggestions	Yes	No
A	improve its relations with other government institution in the field of environmental protection		
B	Help the aggregate industry to implement the environmental laws and regulations		
C	Preparing a technical staff to monitor the quarrying activity		
D	Help the quarry staff to improve their knowledge of environmental protection by providing them with training courses, seminars etc		

F: The Environmental Institutions Role

32-Do you receive any kind of assistance or advice from the environmental institutions as regards to the environmental protection measures?

Yes ☐ No ☐ Don't know ☐

33-Do you receive a regular visits from environmental institutions for work inspection?

Yes ☐ No ☐ Don't know ☐

34-If yes, how regular is it?

a- Weekly☐ b- monthly ☐ c- every 6 months ☐ d- yearly ☐

e- Others:..............................

35-Do they offer courses, seminars, leaflets etc... in relation to environmental protection?

Yes ☐ No ☐ Don't know ☐

D: If you have any other additional comments and suggestions, please state them

....

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The Environmental Impacts of the Libyan Aggregates Industry

PhD Research Project

First Fieldwork Study
(Pre-Research Investigation)
By
Mohamed Masoud

The Fieldwork Form

1. General Information

1.1. Project title:--

1.2. Type of project (Sand, gravel, building stone, other) --------------------------------

----

1.3. Name of the owner (individual, company, etc) --------------------------------------

----

1.4. Name of the person in charge (the responsible person): ----------------------------

Address: --

Telephone No: -----------------------------Fax No------------------------------------

1.5. Competent Administrative Authority:--

2. Project data

2.1 Location of the project (Which county):---

Address of the project: ---

A. City ☐ village ☐ accredited industrial zone ☐ others ☐ (please specify) -------

B. In a residential area ☐ outside a residential area ☐

Total area of the project (Square meter): ---

2.2. Type of project:

New ☐ Extension ☐

Type of extension: --

- *If the type of project is an extension, has an EIA study been submitted for the original project?*

  Yes ☐ No ☐

- Date of obtaining a previous approval from the EGA: -----------------------

2.3 Production capacity: ☐ and/or storage capacity: ☐

2.4. Main products: --

2.5 By-product: --

2.6. A general description of the area surrounding the project including a description of the different activities, historical areas, protected areas, tourist and recreational areas, etc…

2.8. Brief description of the project:

2.8.1 Project components such as machinery, equipment and complementary services

----

2.8.2 Industrial processes (demonstrated as possible by photos)

2.8.3 Power supply used: --------------------------- source: ---------------------------

2.8.4 Type of fuel: ------------------------------ rate of consumption: ---------------------

2.8.5 Raw materials:

Main: ---

Auxiliary: --

2.8.6. Source of water (public, groundwater, surface water, others):----------------------

----

Water usage (cooling, industrial uses, *human use*):---------------------------------------

Rate of consumption: --

2.8. Reasons for choosing the site and the degree of its safety against natural hazards and its compatibility with the neighbouring communities:---------------------------
----

----

3. Environmental Impact Resulted from Aggregate Extraction and Methods of Mitigation:

3.1. Blasting Impacts :--
-- --

3.2. Dust Impacts :-- -- -

3.3. Noise Impacts :-- --

3.4 Water Impacts :-- --

3.5 Visual Impacts :---

3.4 Traffic Impacts :-- --

3.5. Other predicted and significant impacts of the project:--------------------------------

----

3.6. Description of any other measures not mentioned earlier to mitigate the negative impacts of the project : ---

----

3.7. Measures undertaken to protect the health and safety of workers and fire prevention facilities:---

----

3.8. Reasons for choosing the technology used---

3.9. Expected number of workers: ---
